SYNOPSIS OF THE THESIS TO BE SUBMITTED
BY
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DECLARATION

Under Ordinance 770

For the thesis which I intend to submit titled, "A study on critical success factors of Last Mile Delivery practices of E-commerce players in Maharashtra", no Degree or Diploma or Dissertation has been conferred upon me before, either in this or any other University.

Under Ordinance 771

I hereby declare that the study presented by me to the University of Mumbai for the degree of Ph.D. in Management Studies and titled, "A study on critical success factors of Last Mile Delivery practices of E-commerce players in Maharashtra" is in the nature of an original work that has not so far been submitted to any degree of this University or any other University or Institute. Reference to the work and related sources of information have been given at the appropriate place of the thesis.

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Chapter 1: Introduction

Last couple of decades have been quite interesting in terms of the economic development of India. India has been progressing bounds and leaps in almost all the sectors. With the launch of the internet service in the 90's and emergence of cyber cafes to the closure of cybercafes because of the availability of the internet services within the mobile phones, online commerce saw growth in the form of e-commerce and M-commerce.

Since the last few years, one of the differentiating factors for the e-commerce and omni channel retailers has been the delivery promptness. This didn't stop even after same day delivery, instead has gone to a level where in less than two-hour delivery promises have become the norm. This trend has brought in a lot of stress and performance pressure on the logistics industry as well as the last mile delivery partners. These changes in the customer expectations have led to the evolution of more optimised business models including inventory based fulfilment centres and market place strategies. These changing customer preferences have created a need for faster and flexible services at the lowest possible cost. The requirement for complex and more integrated warehousing and distribution services has become the need of an hour. To counter the increasing expectations of the omni channel retailers and e-commerce companies and their customers, logistics companies are exploring newer models such as relay, drop-shipping, aggregation, drone delivery and hyper-local delivery. Technological innovations are playing the key role of an enabler while facilitating timely delivery, enhanced visibility across the supply chain and the flexibility required in terms of last-minute changes in the transaction scenarios.

The above-mentioned challenges make the study more interesting and challenging too.

1.1. E-Commerce industry in India

India's e-commerce landscape has undergone a transformative evolution, positioning itself as one of the fastest-growing digital markets globally. Fuelled by rapid technological adoption, favourable policy frameworks, and shifting consumer behaviour, the sector is poised to redefine retail and commerce across urban and rural India.

1.1.1. Market size

India's online retail market is estimated to be 25% of the total organised retail (8% of the total retail as of FY 2024) and is expected to become 37% by 2030. It is expected to become US$ 160 billion by 2028 (14% of total retail) (IBEF, 2025).

According to the May 2025 IBEF report on E-commerce industry, the Indian e-commerce industry was valued at ₹10.83 lakh crore (US$125 billion) in FY2024 and is projected to reach

₹29.89 lakh crore (US$345 billion) by FY2030, that means it is expected to grow at a compounded annual growth rate (CAGR) of 15% (India Brand Equity Foundation [IBEF], 2025). By FY2035, the market is expected to scale to ₹47.65 lakh crore (US$550 billion), driven by increased digital penetration and consumer engagement. (IBEF, 2025)

1.2. Factors Driving E-commerce Growth in India

1.2.1. Digital Infrastructure and Consumer Base

India had approximately 954.4 million internet subscribers as of March 2024, with smartphone penetration expected to exceed 1.18 billion by FY2026. Notably, rural India is anticipated to contribute over 60% of e-commerce demand by 2026, particularly from Tier 2 to Tier 4 towns (IBEF, 2025). Between FY2019 and FY2026, online shoppers are projected to grow at a CAGR of 22% in rural areas and 15% in urban regions (IBEF, 2025).

India has one of the highest data consumption rate per user of 14.1 GB per person per month and has the second largest number of active internet users in the world. The internet economy is expected to grow six fold to become US$ 1 trillion by 2030 with e-commerce contribution of around 155-175 billion US$ in 2022 (IBEF, 2025). 2024 recorded the India's internet penetration rate at 52.4% of the total population.

1.2.2. Payment Ecosystem and Transaction Trends

Digital payment transactions reached 222.19 billion in FY2025, up from 164.43 billion in FY2024. The Unified Payments Interface (UPI) alone processed over ₹25.75 lakh crore (US$294 billion) in May 2025, marking a 23% year-on-year increase in value and 33% in volume (IBEF, 2025).

1.2.3. Segmental Composition and Consumer Preferences

Fashion and apparel dominate the e-commerce retail segment with a 33% share, followed by beauty and personal care (21%) and smartphones (20%). Social commerce platforms such as Meesho and Flipkart are leveraging social media to drive engagement, with the market expected to reach ₹2.20 lakh crore (US$25.7 billion) by 2029 (IBEF, 2025).

During the year 2022, highest share of e-commerce retail was recorded by smartphones (33%), followed by electronics and appliances (21%), Fashion and apparel (20%), food and FMCG (11%), Furniture and Home décor (6%), Beauty and personal care (4%) and others (5%) (IBEF, 2025).

1.2.4. Policy Support and Investment Landscape

India permits 100% foreign direct investment (FDI) in the B2B and marketplace models under the automatic route. Government initiatives such as Digital India, BharatNet, and the National Logistics Policy have significantly bolstered the sector. Amazon has committed US$26 billion

in investments by 2030, while Walmart plans to infuse over US$2.5 billion according to the IBEF report (IBEF, 2025).

1.2.5. Technological Innovation and Consumer Experience

Retail productivity is expected to enhance by 35 to 37% over the next five years because of the infusion of the Generative AI. Subscription-based models are gaining traction, with Amazon Prime reaching 60 million subscribers as of February 2024. Personalised shopping experiences and voice search technologies are increasingly being adopted to improve user engagement (IBEF, 2025).

1.2.6. Geographic Expansion and Logistics and Warehousing Infrastructure

Tier II and III cities are emerging as growth hubs, supported by initiatives like the Open Network for Digital Commerce (ONDC), which has expanded to over 236 cities and onboarded 36,000+ merchants. Online retailers now serve over 24,000 pin codes, and India's warehousing sector is expected to reach 516 million sq. ft by 2026. Fulfilment centres established by Amazon and Flipkart have enhanced operational efficiency and created employment opportunities. E-commerce is contributing significantly to employment generation of over 15.8 million jobs, including 3.5 million for women (IBEF, 2025).

1.3. Major Indian E-commerce players

Indian E-commerce market is majorly dominated by Flipkart (Approx. 48%), Amazon India (26%), Myntra (22%), IndiaMART (60% market share in industrial goods category), ShopClues, Snapdeal, FirstCry (for child-centric baby products), Nykaa (leading fashion and beauty ecommerce platform, 38% market share in online beauty space), BookMyShow (online ticketing for movies and shows), Meesho (a social ecommerce company with 15% digital users shopping on their platform), Olx India (online platform with 85% market share for resale items) (Jalan, 2025).

1.4. Business Model Frameworks in Indian E-commerce

Indian e-commerce companies most widely use the “Inventory led model” and the “Market place model”.

The Marketplace Model, exemplified by platforms like Amazon India and Flipkart, acts as an intermediary, facilitating transactions between third-party sellers and buyers without owning the inventory. This structure offers high scalability due to decentralized stock management and is highly attractive for foreign investment, permitting 100% FDI under the automatic route. However, the platform has limited control over product quality and pricing, and its logistics and payment functions primarily involve supporting external sellers. Strategically, this model is crucial for MSME digitization and job creation.

In sharp contrast, the Inventory-led Model, seen in businesses like Yepme, involves the platform owning, managing, and selling its own stock directly to consumers, giving it full control over product quality, pricing, and the end-to-end customer experience. The platform handles its own logistics and payment infrastructure. However, this model faces limited scalability as it is capital-intensive due to the full ownership of procurement and warehousing. Crucially, in India, FDI is not permitted in the B2C (Business-to-Consumer) inventory-led model. This approach is better suited for niche brands prioritizing operational control and brand consistency, though it is subject to stricter scrutiny under retail and competition laws.

1.5. Supply Chain Management in E-commerce

Key element behind the success of e-commerce is its supply chain. It affects almost all the aspects of the e-commerce without the customer even realising it. The e-commerce supply chain is a network of processes that involves distinct verticals of an e-commerce business including sourcing, production, distribution, last mile delivery and return (Rebello, 2024). It focuses on smooth coordination between the various partners within a supply chain to ensure maximum customer satisfaction E-commerce supply chain comprises of Sourcing partners, Storage partners, Fulfilment partners, Delivery/ transportation partners and End users/ Customers.

e-Commerce Supply Chain
Sourcing partners
These include vendors such as manufacturers, retailers, and drop-shippers who supply the goods to be sold by the e-commerce companies.
Finished products from vendors are stored in warehouses until customer orders are received.
Storage partners
Fulfilment partners
Customer orders get processed and the ordered products are moved to and packaged at fulfilment centres before being handed over to delivery partners.
The packaged products are delivered by the delivery partners without damage and within the pre-scheduled time and date.
Delivery/ Transportation partners
End-users/ Customers
Customers receive the ordered products and express their satisfaction or their desire to return or replace the product.

Figure 1: E-Commerce Supply Chain, source: (Rebello, 2024)

E-commerce supply chain management (SCM) includes Sourcing and Supplier management, Production and manufacturer management, Logistics and transportation management, Inventory management, Order handling and fulfilment management, Last mile delivery and return management, and Customer relationship management (CRM) (Rebello, 2024).

E-commerce SCM is highly technology based with focus on technology integration, CRM, data analytics and performance management (Rebello, 2024).

Success of e-commerce supply chain lies in its efficiency and speed of delivery, cost reduction by better inventory handling, and its scalability to meet fluctuating demand (Shankar, 2025).

1.5.1. Supply Chain Challenges in e-commerce

E-commerce businesses face several operational hurdles within their supply chains that can significantly impact efficiency and profitability:

- Inventory Management
- Last-Mile Delivery
- Global Shipping and Customs
- Technology Integration

1.5.2. Best Practices for Optimizing E-commerce Supply Chains

To address these challenges, businesses are increasingly adopting innovative strategies that enhance operational resilience and customer experience:

- Real-Time Tracking and Visibility
- Automation and Artificial Intelligence (AI)
- Data-Driven Decision Making (inventory and transportation planning)
- Third-Party Logistics (3PL)

1.6. Role of Last Mile Delivery in E-commerce

Last Mile Delivery (LMD) refers to delivery of goods from a principal transportation centre to a final consumer defined residential destination. This principal transportation centre is normally a local distribution hub located in the vicinity of the delivery point. It is responsible for the satisfaction and delivery of the parcels/ goods to the consumers/ customers within a 10 to 15 kms radial distance.

This operational phase is not simply transportation; it represents a specialized logistic concept requiring "adapted processes" to ensure the delivery outcome achieves two critical, often contradictory, objectives: maximising customer satisfaction and maximizing provider efficiency. The effectiveness of the entire LMD process hinges on the coordinated performance of three key parties: the online retailer/ e-commerce player, the Last Mile Service Provider (LMSP), and the end customer. Depending on the business model, the retailer/e-commerce player may elect to perform the LMD internally or, increasingly common, outsource the function to a 3PL provider (Bopage et al., 2019).

LMD accounts for 30% of the total E-logistics cost, establishing it as one of the principal bottlenecks in e-commerce fulfilment (X. Wang et al., 2014). When assessed against the overall

cost of shipping, LMD costs are even more substantial, comprising 53% overall of the total (Honeywell, 2016). The cost structure is highly sensitive to geography, with the cost per parcel being significantly higher when services are extended to rural areas (Bopage et al., 2019).

1.7. About the study

Multiple studies have also reiterated that the Last mile delivery plays an important role in the satisfaction of the e-commerce customers. Hence, the study focuses on this aspect and tries to study the parameters which affect its success.

The area of the study has been confined to Maharashtra because of the various limitations of the study but at the same time Maharashtra was selected for various strategic reasons.

Maharashtra

Maharashtra is a very important business state of India and contributes 14.2% to the National Gross Domestic Product (Government of Maharashtra, 2025b). It attracted a total of 28.5% of Foreign Direct Investments (FDI) inflows at all India level. The state has a background of entrepreneurship, good road, rail and air transport infrastructure.

Only ten countries in the world have a population greater than that of Maharashtra. The state is a good blend of rural and urban areas. Industrialisation, Migration to the state for Education and Employment from other states, Tourism, Amenities and Facilities, and Economic development have been the reasons of urbanization (Directorate of Town Planning and Valuation Maharashtra State, 2025b).

36 districts of Maharashtra state have been divided in to 6 revenue divisions for administrative purposes namely, Konkan, Pune, Nashik, Chhatrapati Sambhajinagar, Amaravati and Nagpur (State Government of Maharashtra, 2025).

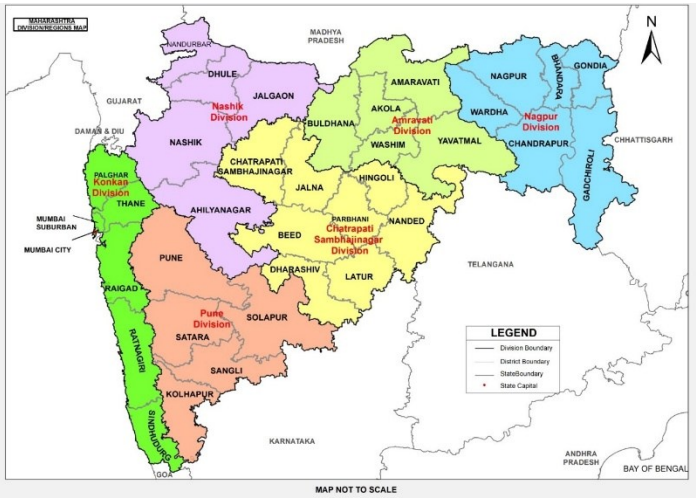

Figure 2: Maharashtra administrative structure, source: (Directorate of Town Planning and Valuation Maharashtra State, 2025a)

The study is focusing on the study of the critical success factors of Last Mile Delivery practices of e-commerce players in Maharashtra.

LMD Performance parameters:

The factors being focussed are from the perspective of the e-commerce players, customers as well as the last mile delivery service providers. The merchant-oriented critical design variables that directly influence LMD performance and are controlled or influenced by the retailer or LMSP include (Bopage et al., 2019): Order visibility, Reliability, Response time, and Returnability.

These factors highlight that the retailer's primary needs revolve around maintaining control over the fulfilment experience and ensuring that LMD performance reinforces customer loyalty and mitigates negative outcomes like returns (Bopage et al., 2019).

The last mile operational performance parameters focus on resource utilisation, service quality assurance, lean infrastructure, and environmental impact. It has been observed that delivery speed, on-time delivery (punctuality) and safety and security related to the product delivery needs to be addressed for better service quality assurance. A segment of customers are willing to pay extra for reliable and timed delivery (Honeywell, 2016).

The framework suggested by Bopage et al., 2019, stresses that the alignment of operational system will lead to meeting the key stake holder expectations. The successful operation of the LMD system is thus measured by achieving optimized performance across these stakeholder expectations (Bopage et al., 2019) which includes LMSP Expectations, Retailer Expectations, and Customer Expectations.

Chapter 2: Literature Review

Literature review becomes a very important part of the study as it provides with the necessary insights and trends related to the study area. It helps in identify the research gaps and formulation of research objectives of the study. Structured literature review has been conducted to better understand the study area and identify the gaps.

To ensure methodological transparency and replicability, a Structured Literature Review (SLR) approach was adopted, strictly adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page, McKenzie, et al., 2021) (Page, Moher, et al., 2021). Furthermore, the systematic analysis of the scholarly landscape was quantitatively executed through bibliometric methods, utilizing the Bibliometrix package within the R-Studio computing environment (Aria & Cuccurullo, 2017).

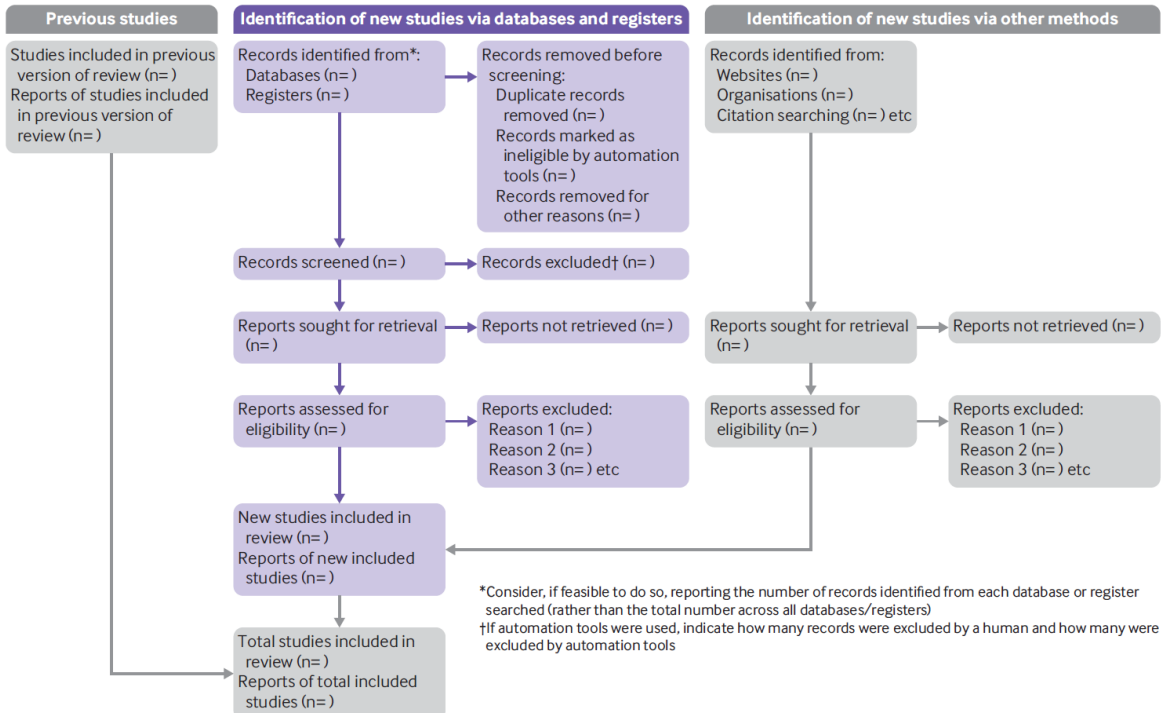
Previous studies
Identification of new studies via databases and registers
Identification of new studies via other methods
Studies included in previous version of review (n=)
Reports of studies included in previous version of review (n=)
Records identified from*:
Databases (n=)
Registers (n=)
Records removed before screening:
Duplicate records removed (n=)
Records marked as ineligible by automation tools (n=)
Records removed for other reasons (n=)
Records identified from:
Websites (n=)
Organisations (n=)
Citation searching (n=) etc
Records screened (n=)
Records excluded† (n=)
Reports sought for retrieval (n=)
Reports not retrieved (n=)
Reports sought for retrieval (n=)
Reports not retrieved (n=)
Reports assessed for eligibility (n=)
Reports excluded:
Reason 1 (n=)
Reason 2 (n=)
Reason 3 (n=) etc
Reports assessed for eligibility (n=)
Reports excluded:
Reason 1 (n=)
Reason 2 (n=)
Reason 3 (n=) etc
New studies included in review (n=)
Reports of new included studies (n=)
Total studies included in review (n=)
Reports of total included studies (n=)
*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers)
†If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools

Figure 3: PRISMA 2020 flow diagram template for systematic reviews (Page, McKenzie, et al., 2021) (Page, Moher, et al., 2021).

The primary corpus for the bibliometric analysis was systematically derived from two principal academic repositories: the SCOPUS and Web of Science databases. Following the rigorous quantitative filtering phase of the bibliometric analysis, the resultant body of relevant scholarly

literature, encompassing peer-reviewed articles, doctoral theses, and other high-impact scholarly items, was then subjected to thematic categorisation.

This classification process resulted in the establishment of four core thematic streams, designed to structure the qualitative synthesis of the subsequent literature review: E-commerce Consumer Preference Studies, Operational Practices in Last-Mile Delivery (LMD), Determinants of LMD Performance and Conceptual Frameworks, and Optimisation Methodologies for LMD Logistics.

2.1 Bibliometric Analysis:

Structured literature review was undertaken for the references extracted from the SCOPUS and Web of Science (WOS) databases using PRISMA framework as indicated in the figure below. The objective of PRISMA framework adoption was to achieve better reliability and focussed approach.

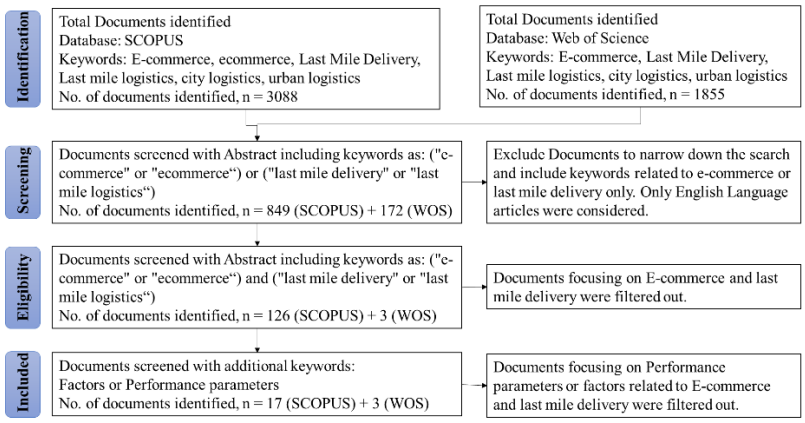
Identification
Total Documents identified
Database: SCOPUS
Keywords: E-commerce, ecommerce, Last Mile Delivery, Last mile logistics, city logistics, urban logistics
No. of documents identified, n = 3088
Total Documents identified
Database: Web of Science
Keywords: E-commerce, Last Mile Delivery, Last mile logistics, city logistics, urban logistics
No. of documents identified, n = 1855
Screening
Documents screened with Abstract including keywords as: ("e-commerce" or "ecommerce") or ("last mile delivery" or "last mile logistics")
No. of documents identified, n = 849 (SCOPUS) + 172 (WOS)
Exclude Documents to narrow down the search and include keywords related to e-commerce or last mile delivery only. Only English Language articles were considered.
Eligibility
Documents screened with Abstract including keywords as: ("e-commerce" or "ecommerce") and ("last mile delivery" or "last mile logistics")
No. of documents identified, n = 126 (SCOPUS) + 3 (WOS)
Documents focusing on E-commerce and last mile delivery were filtered out.
Included
Documents screened with additional keywords: Factors or Performance parameters
No. of documents identified, n = 17 (SCOPUS) + 3 (WOS)
Documents focusing on Performance parameters or factors related to E-commerce and last mile delivery were filtered out.

Figure 4: PRISMA flowchart for Bibliometric analysis of references from SCOPUS and WOS database

The dataset search was finetuned based on the PRISMA guidelines so that more relevant research papers can be identified and used as main references for the study. SCOPUS database resulted in 3088 results whereas WOS gave 1855 references. When checked for duplicate results, WOS resulted in only 172 new results.

Table 1: Inclusion criteria for paper selection.

Database	SCOPUS, Web of Science and other sources
Analysed Field	Title, Abstract, Keywords
Search Phrase	(“ecommerce” OR “e-commerce”) AND (“last mile delivery” OR “last mile logistics” OR “city logistics” OR “urban logistics”) OR (“criteria” OR “factors” OR “performance parameters”)
Document Types	Articles from Journals, Books
Language	English
Source Type	Peer Reviewed
Time Interval	1959–2025
Final number of articles analysed for the review	125

Results fine tuning was done by clubbing keywords like “E-Commerce” and “ecommerce”, “Last mile delivery” and “last mile logistics” and other similar words. When the two keywords were grouped and searched for their simultaneous occurrence, the search result reduced to just 129 references (126 from SCOPUS and 3 from WOS). This reduced further to just 20 references (17 from SCOPUS and 3 from WOS) with the addition of keywords like “criteria” or “performance parameters” or “factors”.

Since the no. of unique references from WOS were very less as compared to SCOPUS database, only results extracted from SCOPUS dataset was considered for bibliometric analysis. Relevant references from the WOS result were hand picked for detailed literature review.

To understand the existing research landscape regarding critical success factors in last-mile delivery practices, particularly within the e-commerce context, a bibliometric analysis was conducted using a dataset extracted from the Scopus database. The dataset, spanning from 1959 to 2025, encompassed 3,088 documents, offering a comprehensive overview of the field.

Figure 5: Brief summary of the SCOPUS database references

The collection includes articles from 1,214 different sources (journals, books, etc.), indicating a broad dissemination of research findings across various academic outlets. The annual growth rate of 5.83% suggests a steadily increasing interest and research activity in last-mile delivery over the analysed period. The publication of 3,088 documents between 1959 and 2025 highlights the substantial volume of scholarly work dedicated to this topic. However, the average document age of 4.38 years points towards rapidly evolving field where recent research likely holds significant importance. This necessitates a focus on contemporary studies to capture the most current trends and challenges in last-mile delivery.

The average of 16.94 citations per document provides a preliminary indication of the impact and influence of the research within the collection. The dataset includes 99,664 references,

demonstrating the interconnectedness of the research and the reliance on prior knowledge within the domain of last-mile delivery.

The presence of 10,854 Keywords Plus (ID) and 6,516 Author's Keywords (DE) provides valuable insights into the key themes and topics investigated within the literature. Further analysis of these keywords is crucial for identifying the specific critical success factors, technological advancements, and operational strategies that have been the focus of research in last-mile delivery.

The keyword field demonstrates the diverse research areas within last mile delivery. "E-commerce" and "urban logistics" are prominent themes, alongside more specific topics such as "vehicle routing problems," "trucks", "sustainability" and "fleet operations". The Three field plot shows connections between these keywords and specific authors (e.g., Li Y. and the keyword "last mile delivery efficiency in B2C e-commerce") indicate specialized research niches and potential areas for further exploration.

Author’s productivity over time indicated authors like Winkenbach M., and Wang X. show early high impactful publications. Recent research output, particularly after 2020, shows a high density of publications with impactful TC/year ratios across all authors.

Based on the most cited publications, some trending themes emerge:

- Self-Service Delivery: Several authors (Chen Y., Wang S., Wang X., Yuen KF.) have highly cited works focusing on consumer adoption of self-service parcel delivery, including parcel lockers and automated parcel stations. This suggests significant research interest in understanding consumer behaviour in this evolving delivery landscape.
- Drone Delivery: Authors like Li Y., Li X., Winkenbach M., and Liu X. have contributed significantly to the literature on drone-aided delivery, exploring various aspects such as routing optimization, energy efficiency, and system design.
- Optimization and Routing: The works by Wang H., Liu Y., and Wang S. highlight research on optimization techniques for last-mile delivery, encompassing routing, scheduling, and workload assessment, often incorporating innovative approaches like hybrid algorithms and mobile parcel lockers.
- Sustainability: Li Y. and Wang H. also present research focused on the sustainability aspects of last-mile delivery, with attention to drone delivery, rural e-commerce, and the role of various stakeholders.

Wang X. demonstrates high research productivity in early years, focusing on the customer's intention to use self-collection services for last-mile delivery (X. Wang et al., 2018) (W. Wang et al., 2019). These studies offer a foundational understanding of consumer behaviour and preferences related to alternative delivery methods. Meanwhile, recent studies like that of Wang S. (2020) (Zhou et al., 2020) continue to explore these trends by understanding consumers' behaviour toward the adoption of self-service parcel services for last-mile delivery. Optimization strategies in this field are also an active area of study, as evidenced by Wang H.'s research on routing and scheduling (H. Wang, 2019) and Liu Y.'s studies on vehicle routing problems with drones (Liu et al., 2022). Additionally, a stream of research addresses sustainability considerations in last-mile delivery, including investigations into the use of drones (Li et al., 2023) and sustainable practices in rural e-commerce logistics (H. Wang, 2019).

Most Frequent keywords:

Bibliometric analysis using the Bibliometric package (Aria & Cuccurullo, 2017) facilitated the analysis of most frequently used words. It helps in identifying the other closely related area and sub areas which are affecting the e-commerce last mile delivery study. Most frequent words used is analysed using a WordCloud and a TreeMap representations are as indicated below.

Figure 6: WordCloud representation of most frequent words used for references in SCOPUS database

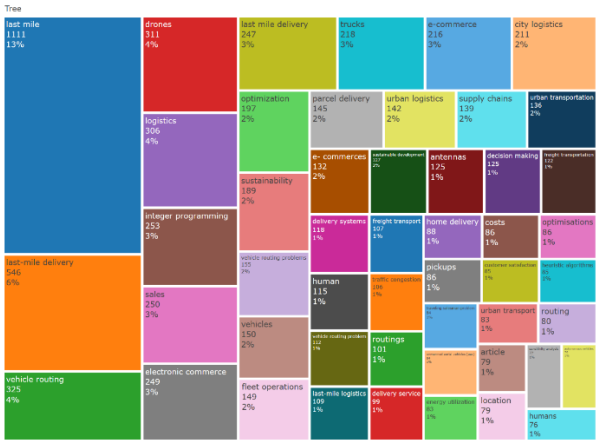

Figure 7: TreeMap representation of most frequent words used for references in SCOPUS database

Keywords like last mile, delivery, vehicle routing, drones, logistics, integer programming, electronic commerce, vehicles, city logistics, urban logistics, urban transportation, optimization, sustainability, fleet operations, parcel delivery, supply chains, and other similar terms.

Broady it can be summarised that the focus had been around e-commerce or other business applications, last mile delivery operations, planning and optimisation, technology solutions and sustainability.

A word co-occurrence network, visualised using Biblioshiny (Aria & Cuccurullo, 2017), reveals key themes and relationships within the existing literature. It displays a multi-clustered structure, indicative of several distinct, yet interconnected, research areas within last-mile delivery.

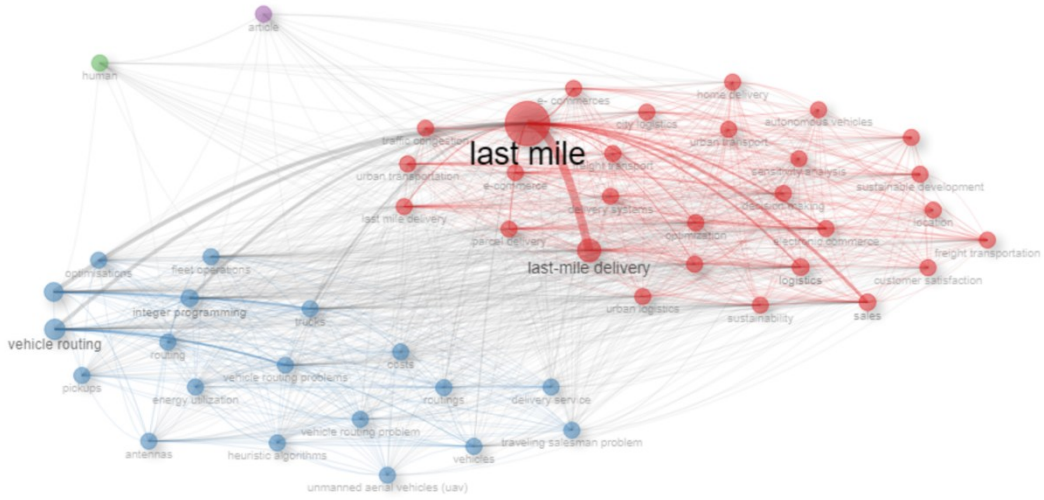

Figure 8: Word Co-occurrence Network for references in SCOPUS database

The network displays a multi-clustered structure, indicative of several distinct, yet interconnected, research areas within last-mile delivery. The network is composed of three prominent clusters:

- Cluster 1: Last Mile and Logistics (Red Cluster): This cluster, centrally positioned, highlights the core themes of "last mile" and "last-mile delivery." Highly connected terms within this cluster include "e-commerce," "logistics," "urban transport," "customer satisfaction," "home delivery" and "sustainability". This suggests a strong focus in the literature on the challenges and opportunities of last-mile delivery in the context of growing e-commerce, urban environments, and the increasing importance of sustainable practices, e.g. (Arslan et al., 2019); (Boysen et al., 2020).
- Cluster 2: Vehicle Routing and Optimization (Blue Cluster): This cluster centers around "vehicle routing" and related optimization techniques. This indicates a significant body of research focused on optimising delivery routes and fleet management, likely leveraging mathematical and computational methods to enhance efficiency and reduce costs (Ghiani et al., 2024).

- Cluster 3: Article and Human Factors (Purple and Green Cluster): This cluster, with keywords "article" and "human" appear to be a weakly connected and could mean that this literature is not connected to the main research on last mile delivery.

Relevance to the study:

- The centrality of the "last mile" and "last-mile delivery" terms underscores the importance of the research area within the broader logistics and e-commerce landscape.
- The strong connection between "e-commerce" and "logistics" emphasizes the need to examine last-mile delivery practices within the specific context of e-commerce operations in Maharashtra. Understanding the nuances of this relationship is crucial for identifying relevant success factors.
- The optimisation cluster highlights the potential for leveraging routing algorithms and technology to improve delivery efficiency, an area ripe for investigation within the specific geographic and infrastructural context of Maharashtra.
- The connection between "sustainability" and "urban transport" suggests a growing awareness of the environmental impact of last-mile delivery, which could be a critical success factor, especially in urban areas like those in Maharashtra.

Thematic Categorisation of Top Keywords

After consolidating similar terms (e.g., "e-commerce" and "ecommerce," or "last mile delivery" and "last-mile delivery"), the keywords fall into four main research themes:

Table 2: Thematic categorisation of top keywords

Theme	Keyword	Frequency	Key Insights
I. The Core Problem	Last mile delivery	373	The central focus of all research: the high cost, complexity, and customer-facing nature of the final delivery leg.
	E-commerce	281	The driving force and context for the last mile challenge.
II. Operational Context	City logistics	190	The primary operating environment; emphasizes urban constraints like traffic, density, and regulation.
	Last mile logistics	94	The broader academic field and supply chain management perspective.
	Urban logistics	44	Focuses on the system and infrastructure within cities.
	Logistics	57	The general field and management principles.

Theme	Keyword	Frequency	Key Insights
III. Technology & Methods	AI/ Machine Learning	234	The single largest theme of applied solutions; indicates a massive focus on data science for optimization.
	Drones / UAVs	59	Explores uncrewed aerial vehicles as an alternative delivery method.
	Electric Vehicles	89	Focuses on vehicle types for sustainability and compliance.
	Vehicle Routing Problem (VRP)	41	The core mathematical challenge being solved by AI/ML.
IV. Solutions & Alternatives	Crowd Logistics/ Crowd shipping	42	Utilising non-traditional (gig-economy/public) networks for delivery.
	Parcel delivery	34	Focuses on the item being delivered.
	Cargo bikes	26	Explores micro-mobility and non-motorized solutions for urban areas.
	Parcel lockers	26	Focuses on out-of-home delivery locations to improve efficiency and convenience.

2.2 Thematised literature review:

Handpicked research articles were selected based on their importance and relevance were selected for detailed review and relevant information extraction to guide the study appropriately. The prominent articles have been categorised as under:

1. E-commerce Consumer Preference

1. Vakulenko, Y., Shams, P., Hellström, D., & Hjort, K. (2019). Online retail experience and customer satisfaction: the mediating role of last mile delivery (p. 20).
2. Kiba-Janiak, M., Cheba, K., Mucowska, M., & de Oliveira, L. K. (2022). Segmentation of e-customers in terms of sustainable last-mile delivery (pp. 5-6).
3. Mogire, E., Kilbourn, P. J., & Luke, R. (2023). Customer satisfaction with last-mile delivery in Kenya: An online customer perspective (p. 7).
4. Caspersen, E., & Navrud, S. (2021). The sharing economy and consumer preferences for environmentally sustainable last mile deliveries (p. 4).
5. Zhong, S., Lomas, C., & Worth, T. (2022). Understanding customers' adoption of express delivery service for last-mile delivery in the UK (pp. 4-5).
6. Borghetti, F., et al. (2022). The Use of Drones for Last-Mile Delivery: A Numerical Case Study in Milan, Italy (pp. 3-4).
7. Olsson, J., Hellström, D., & Vakulenko, Y. (2023). Customer experience dimensions in last-mile delivery: an empirical study on unattended home delivery (pp. 29-30).

8. Hayel, Y., Quadri, D., Jiménez, T., & Brotcorne, L. (2016). Decentralized optimization of last-mile delivery services with non-cooperative bounded rational customers (pp. 9-10).
9. Escudero, A., Muñuzuri, J., Lorenzo-Espejo, A., & Muñoz-Díaz, M. L. (2022). Improving E-Commerce Distribution through Last-Mile Logistics with Multiple Possibilities of Deliveries Based on Time and Location (p. 23).
10. Perboli, G., et al. (2021). A new model for Last-Mile Delivery and Satellite Depots management: The impact of the on-demand economy (pp. 14-15).
11. Vrhovac, V., et al. (2023). Measuring E-Commerce User Experience in the Last-Mile Delivery (pp. 10-11).
12. Wang, X., Zhan, L., Ruan, J., & Zhang, J. (2014). How to choose "last mile" delivery modes for E-fulfillment (p. 37).

2. Operational Practices in Last-Mile Delivery (LMD)

13. Gevaers, R., Van de Voorde, E., & Vanelslander, T. (2011). Characteristics and Typology of Last-mile Logistics from an Innovation Perspective in an Urban Context (p. 1).
14. Allen, J., Browne, M., Woodburn, A., & Leonardi, J. (2012). The Role of Urban Consolidation Centres in Sustainable Freight Transport (p. 1).
15. Alharbi, A., Cantarelli, C., & Brint, A. (2022). Crowd Models for Last Mile Delivery in an Emerging Economy (p. 2).
16. Bopage, G., Nanayakkara, J., & Vidanagamachchi, K. (2019). A Strategic Model to Improve the Last Mile Delivery Performance in E-commerce Parcel Delivery (pp. 9-10, 39).
17. Turská, S., et al. (2018). Delivery Models in Last Mile Logistics (p. 29).
18. Gonzalez-Calderon, C. A., et al. (2022). Cargo bicycles as an alternative to make sustainable last-mile deliveries in Medellin, Colombia (p. 3).
19. Eliyan, A., Elomri, A., & Kerbache, L. (2021). The last-mile delivery challenge: evaluating the efficiency of smart parcel stations (pp. 17-18).
20. Janjevic, M., Winkenbach, M., & Merchán, D. (2019). Integrating collection-and-delivery points in the strategic design of urban last-mile e-commerce distribution networks (pp. 18-19).

21. Bergmann, F. M., Wagner, S. M., & Winkenbach, M. (2020). Integrating first-mile pickup and last-mile delivery on shared vehicle routes for efficient urban e-commerce distribution (pp. 19-20).
22. Datta, P. P. (2018). Decision framework for selecting last mile delivery performance in Indian e-commerce companies (pp. 40, 42).
23. Boysen, N., Fedtke, S., & Schwerdfeger, S. (2020). Last-mile delivery concepts: a survey from an operational research perspective (pp. 16-17).
24. Pahwa, A., & Jaller, M. (2022). A cost-based comparative analysis of different last-mile strategies for e-commerce delivery (p. 26).
25. Demir, E., Syntetos, A., & Van Woensel, T. (2022). Last mile logistics: Research trends and needs (pp. 37-38).

3. Determinants or factors of LMD Performance and Conceptual Frameworks

26. Savelsbergh, M., & Van Woensel, T. (2016). 50th Anniversary Invited Article—City Logistics: Challenges and Opportunities (p. 1).
27. Bakogianni, M. A., & Malindretos, G. (2021). Last mile deliveries in the framework of urban distribution and supply chain management: review of best practices and conceptual framework (p. 6).
28. Mogire, E., Kilbourn, P., & Luke, R. (2022). The Last Mile Delivery Problem: A Kenyan Retail Perspective (p. 13).
29. Nguyen, N., Tran, T. H., Luu, T. T., & Vu, T. D. (2023). Crowdshippers' intentions to continue participating in last-mile delivery: A study in Vietnam (pp. 7-8).
30. Campisi, T., et al. (2023). A literature review of the main factors influencing the e-commerce and last-mile delivery projects during COVID-19 pandemic (pp. 8-9).
31. Suguna, M., et al. (2022). A study on the influential factors of the last mile delivery projects during Covid-19 era (pp. 15-16).
32. Mismar, H., Shamayleh, A., & Qazi, A. (2022). Prioritizing Risks in Last Mile Delivery: A Bayesian Belief Network Approach (p. 12).
33. Prajapati, D., et al. (2020). A Clustering Based Routing Heuristic for Last-Mile Logistics in Fresh Food E-Commerce (pp. 22-23).
34. Prahastyantoro, R., et al. (2022). E-Commerce Parcel Distribution in Urban Areas with Sustainable Performance Indicators (pp. 23-24).
35. Muñoz-Villamizar, A., et al. (2021). Measuring Disruptions in Last-Mile Delivery Operations (p. 34).

36. Zeng, Y., Tong, Y., & Chen, L. (2019). Last-Mile Delivery Made Practical: An Efficient Route Planning Framework with Theoretical Guarantees (pp. 24-25).
37. Wang, C. N., et al. (2021). Evaluating Sustainable Last-Mile Delivery (LMD) in B2C E-Commerce Using Two-Stage Fuzzy MCDM Approach: A Case Study From Vietnam (pp. 38-39).
38. Seung, Y. K., Cho, S. W., & Lee, C. (2018). Pricing and Collaboration in Last Mile Delivery Services (p. 35).
39. Archetti, C., & Bertazzi, L. (2020). Recent challenges in Routing and Inventory Routing: E-commerce and last-mile delivery (pp. 11-12).
40. Ranathunga, M. I. D., Wijayanayake, A., & Niwunhella, D. (2021). Solution approaches for combining first-mile pickup and last-mile delivery in an e-commerce logistic network: A systematic literature review (pp. 26-27).
41. Viu-Roig, M., & Alvarez-Palau, E. J. (2020). The impact of E-Commerce-related last-mile logistics on cities: A systematic literature review (pp. 12-13).
42. Olsson, J., Hellström, D., & Pålsson, H. (2019). Framework of last mile logistics research: A systematic review of the literature (p. 14).
43. Kumar, I., & Chidambara. (2024). A systematic literature review and bibliometric analysis of last-mile E-commerce delivery in urban areas (p. 22).

4. Optimisation Methodologies for LMD Logistics

44. Chu, H., et al. (2023). Data-driven optimization for last-mile delivery (pp. 1-2).
45. Martinez-Sykora, A., et al. (2020). Optimised solutions to the last-mile delivery problem in London using a combination of walking and driving (p. 11).
46. Shaklab, E., et al. (2023). Towards Autonomous and Safe Last-mile Deliveries with AI-augmented Self-driving Delivery Robots (p. 15).
47. Tilk, C., Olkis, K., & Irnich, S. (2021). The last-mile vehicle routing problem with delivery options (p. 18).
48. zark, S. S., Veelenturf, L. P., Van Woensel, T., & Laporte, G. (2021). Optimizing e-commerce last-mile vehicle routing and scheduling under uncertain customer presence (p. 24).
49. Prajapati, D., et al. (2020). A Clustering Based Routing Heuristic for Last-Mile Logistics in Fresh Food E-Commerce (pp. 22-23).
50. Kunnapapdeelert, S., Johnson, J. V., & Phalitnonkiat, P. (2022). Green last-mile route planning for efficient e-commerce distribution (pp. 25-26).

51. Tiwari, K. V., & Sharma, S. K. (2023). An optimization model for vehicle routing problem in last-mile delivery (p. 26).
52. Liu, W. (2020). Route Optimization for Last-Mile Distribution of Rural E-Commerce Logistics Based on Ant Colony Optimization (pp. 39-40).
53. Reed, S., Campbell, A. M., & Thomas, B. W. (2024). Does parking matter? The impact of parking time on last-mile delivery optimization (pp. 34-35).
54. Yuan, Y. (2021). Models and algorithms for last mile delivery problems with multiple shipping options (p. 38).
55. Brochado, Â. F., Rocha, E. M., Addo, E., & Silva, S. (2024). Performance Evaluation and Explainability of Last-Mile Delivery (p. 17).
56. Nagpal, G., et al. (2021). Use of data analytics to increase the efficiency of last mile logistics for ecommerce deliveries (pp. 21-22).

5. Other concepts of relevance

57. Parasuraman, A. (2013). Finding Service Gaps in the Age of e-Commerce | Harvard Business Publishing Education (Focuses on adapting SERVQUAL for online experience) (pp. 20-21, 27).
58. Godsell, J., et al. (2006). Customer responsive supply chain strategy: An unnatural act? (p. 31).
59. Yapa, S. T. W. S. (2018). Factors Influencing Supply Chain Responsiveness in the Apparel Industry in Sri Lanka (pp. 31-32).
60. Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis (pp. 40-41).
61. Page, M. J., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews (pp. 41-42).
62. Page, M. J., et al. (2021). PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews (pp. 41-42).
63. Weijters, B., Cabooter, E., & Schillewaert, N. (2010). The effect of rating scale format on response styles: The number of response categories and response category labels (p. 28).
64. Revilla, M. A., Saris, W. E., & Krosnick, J. A. (2014). Choosing the Number of Categories in Agree-Disagree Scales (pp. 28-29).
65. Luiss, V. F., Carli, G., & Candidate, V. F. (2022). Blockchain technology and Last Mile delivery (p. 11).

66. Galkin, A., et al. (2019). Last-Mile Delivery for Consumer Driven Logistics (p. 26).
67. Rautela, H., Janjevic, M., & Winkenbach, M. (2021). Investigating the financial impact of collection-and-delivery points in last-mile E-commerce distribution (p. 24).

Extracts from some very prominent research articles and reports are as indicated below:
According to a McKinsey report (2016) titled "How customer demands are reshaping last-mile delivery" published in 2016, a large share of consumers are willing to pay extra for same day or instant delivery (McKinsey & Company, 2016).
The delivery mode, velocity, time slot are variables that are parts of Marchet et al. (2018) framework and describes several logistics variables that represent retailers. Another variable that is described is delivery fee. These variables are of interest to observe how retailers stay competitive when it comes to the last mile delivery (Marchet, Melacini, Perotti, Rasini, & Tappia, 2018).
Gayani Bopage (2019) has focused the study on last mile delivery of B2C merchandise. The study was covered in three parts namely, i) Last mile delivery, ii) Behavioral patterns of key parties engaged in Last mile delivery and iii) Factors affecting for the performance of last mile delivery (Bopage, Nanayakkara, & Vidanagamachchi, 2019).
The figure below summarises the factors considered for the study. delivery convenience, speed of delivery and delivery reliability were considered for studying consumer satisfaction. The study also throws light on the three last mile delivery models: (i) attended home delivery (AHD), (ii) reception box (RB) and (iii) collection-and-delivery points (CDPs). Factors like delivery mode, time, area and returns were used to study retailer behaviour. (Bopage, Nanayakkara, & Vidanagamachchi, 2019)
Factors affecting the last mile delivery efficiency was observed as (i) lack of economies of scale: one package per drop, (ii) locating specific home address of the consumer, and (iii) Not-at-home problem resulting into failed and empty trips. (Bopage, Nanayakkara, & Vidanagamachchi, 2019)
M. Sugana has identified the major factors influencing the last mile delivery during COVID as Customers' expectations, Health, Delivery density, Cost of last mile delivery, Types of goods, Achieving routing efficiency, Infrastructure, Issues from customers' side, Unpredictability in transit, and Meeting fulfilment timeline. (M, Shah, S, & M, 2021)
Christian Tilk in his research article titled "The last-mile vehicle routing problem with delivery options" has introduced and analysed the vehicle routing problem with delivery options (VRPDO) with requests being shipped to alternative locations requiring different delivery time

windows and delivery options. The solution suggested is based on new branch-price-and-cut algorithm. (Tilk, Olkis, & Irnich, 2021)

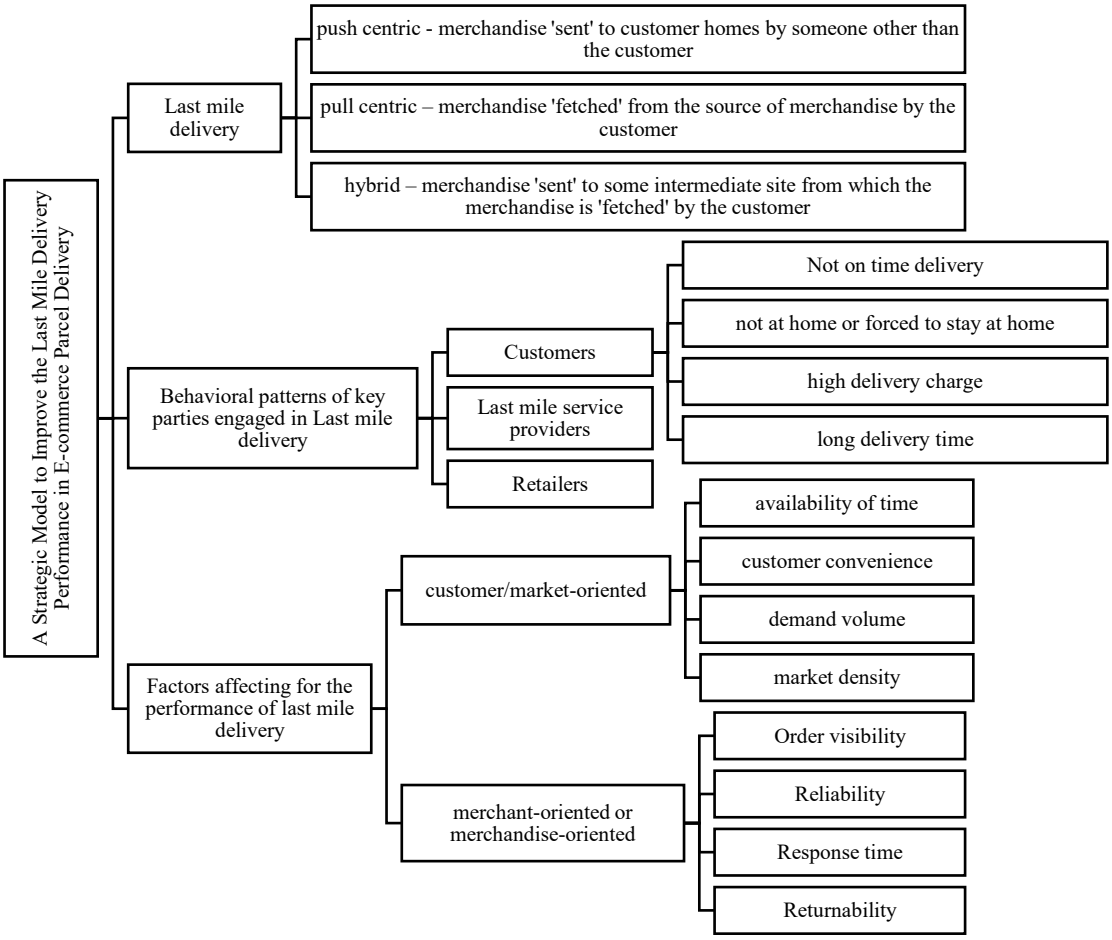
A Strategic Model to Improve the Last Mile Delivery Performance in E-commerce Parcel Delivery
Last mile delivery
push centric - merchandise 'sent' to customer homes by someone other than the customer
pull centric – merchandise 'fetched' from the source of merchandise by the customer
hybrid – merchandise 'sent' to some intermediate site from which the merchandise is 'fetched' by the customer
Behavioral patterns of key parties engaged in Last mile delivery
Customers
Not on time delivery
not at home or forced to stay at home
high delivery charge
long delivery time
Last mile service providers
Retailers
Factors affecting for the performance of last mile delivery
customer/market-oriented
availability of time
customer convenience
demand volume
market density
merchant-oriented or merchandise-oriented
Order visibility
Reliability
Response time
Returnability

Figure 9: Factors considered for the study (Bopage, Nanayakkara, & Vidanagamachchi, 2019)

Yezekael Hayel has proposed a queuing model for two last-mile delivery services for competing consumers. This work was derived from a real-world e-commerce application. The article was used to prove the existence and uniqueness of congestion/routing games: Wardrop and Logit equilibria. They compared them using the Price of Rationality and Anarchy. The study was focused at home delivery and customers pickup services. (Hayel, Quadri, Jiménez, & Brotcorne, 2016)

Antonio Martinez-Sykora presents an optimisation model that integrates driving and walking element while describing a branch-and-cut algorithm for the last mile delivery. The study was conducted in London. (Sykora, McLeod, Fernandez, & Bektas, 2020)

Gayani Bopage in the paper titled “A Strategic Model to Improve the Last Mile Delivery Performance in E-commerce Parcel Delivery” focuses on eliminating the inefficiencies in last mile delivery by identifying the factors important for its stake holders. The article suggests a

model that can be used by the last mile logistics service providers during strategy implementation to meet customer and retailer expectations while managing service costs. (Bopage, Nanayakkara, & Vidanagamachchi, A Strategic Model to Improve the Last Mile Delivery Performance in E-commerce Parcel Delivery, 2019)

John Olsson in his research paper titled "Framework of Last Mile Logistics Research: A Systematic Review of the Literature" reviewed 155 peer reviewed journal publications addressing last mile delivery emerging trends, practices, performance optimisation and policy formulation, supply chain structures and performance measurement. The paper provides a good back ground study base. (Olsson, Hellström, & Pålsson, 2019)

2.3 Research Gap Analysis

Bibliometric Analysis using Biblioshiny indicated that interest in the area of Last mile delivery has increased since 2006 and onwards. The timeline is coinciding with the emergence of e-commerce in India too. The average document age of 4.38 years indicates rapid evolution in last mile delivery and associated domains. The diverse areas within Last mile delivery appeared to be e-commerce, urban logistics, vehicle routing, fleet operations and sustainability. New trends include self service delivery, Drone delivery and UAVs.

The SCOPUS and Web of Science databases returned a total of 129 reference when the keywords like "E-Commerce" and "ecommerce", "Last mile delivery" and "last mile logistics" and other similar words were clubbed together. This search result reduced to just 3 with the addition of keywords like "criteria" or "performance parameters" or "factors".

A significant number of papers are available in the context of US, Europe and China. Though India appears to be in the fifth position with approximately 103 articles in the domain, the gap with the leading players is quite phenomenal.

Research Gap

A significant gap in the literature exists in the Indian context in the following ways –

- Very few studies are available covering last mile delivery and e-commerce collectively.
- Hardly any study exists which addresses performance parameters of last mile delivery of e-commerce.

- Not much literature in Indian context on women entrepreneurs mixing narratives analysis with quantitative dimension is available.

2.4 Conceptual Framework and Hypotheses Development

The review of literature on last-mile delivery (LMD) practices highlights that delivery performance factors such as delivery efficiency and delivery quality play a crucial role in shaping customer experiences and perceptions of service reliability. Prior studies on logistics and service quality (e.g., Parasuraman et al., 1988; Mentzer et al., 2001; Mangiaracina et al., 2019) suggest that reliable, timely, and professionally executed deliveries build customer confidence in e-commerce platforms. Drawing upon these insights, the present study proposes a conceptual framework that integrates delivery performance, customer trust, and satisfaction as core constructs influencing the overall success of last-mile delivery practices.

Delivery Efficiency and Customer Trust.

Delivery efficiency refers to the extent to which orders are fulfilled accurately, promptly, and in good condition. Efficient delivery operations demonstrate a firm's reliability and operational competence, thereby strengthening customer trust. When consumers perceive that deliveries are consistently on time and packages arrive in satisfactory condition, they are more likely to regard the service as dependable. Accordingly, the study hypothesises a positive relationship between delivery efficiency and customer trust and reliability.

Delivery Quality and Customer Trust.

Beyond timeliness, the quality of the delivery experience—courtesy of personnel, smoothness of process, and problem-free interactions—contributes significantly to customers' perceptions of service integrity. High-quality delivery interactions signal professionalism and care, reinforcing consumer confidence. Thus, a positive effect of delivery quality on customer trust and reliability is proposed.

Customer Trust and Customer Satisfaction.

Trust is a central component of long-term customer relationships and has been widely recognised as a key antecedent of satisfaction in online retailing (Gefen, 2000; Kim et al., 2009). When customers trust that the service provider safeguards their interests, ensures data

security, and consistently fulfils promises, overall satisfaction tends to rise. Hence, the model posits that customer trust and reliability have a direct positive effect on customer satisfaction.

Mediating Role of Customer Trust.

Trust often serves as a psychological bridge linking performance perceptions to satisfaction. Delivery efficiency and quality may not directly translate into satisfaction unless customers first develop confidence in the service. Therefore, the framework anticipates that customer trust mediates the relationship between delivery performance factors and customer satisfaction.

Influence of Consumer Behavioural Factors.

The literature also indicates that consumers' purchase motivations—such as convenience, price discounts, or urgency—and the type of products purchased influence their expectations of delivery performance (Clemes et al., 2014; Esper et al., 2020). Accordingly, Purchase Motivation and Shopping Category are included as additional predictors of customer satisfaction.

The relationships among these constructs are depicted in the proposed conceptual model (Figure below). This model forms the empirical foundation for the study and provides the basis for the set of null and alternative hypotheses presented in the following section.

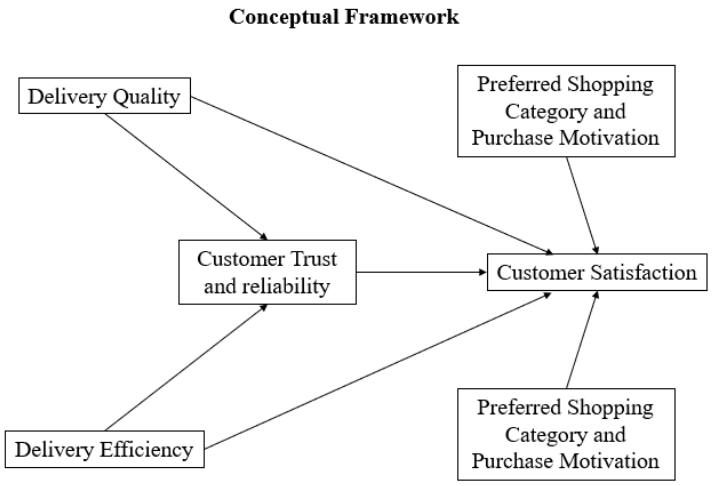

Figure 10: Conceptual framework of study

The conceptual model presented in Figure above illustrates the proposed relationships among the major constructs of the study, reflecting the customer perspective of last-mile delivery

(LMD) performance in the e-commerce sector of Maharashtra. The model conceptualises Delivery Efficiency and Delivery Quality as the primary delivery performance factors influencing both Customer Trust and Reliability and Customer Satisfaction. It further posits that Customer Trust and Reliability act as a mediating variable, explaining how efficient and high-quality deliveries translate into customer satisfaction. Additionally, Purchase Motivation and Shopping Category are included as control or contextual variables that directly influence Customer Satisfaction by shaping consumers' expectations and perceptions of delivery experiences. Together, these relationships form the analytical framework tested through Structural Equation Modelling (SEM), aimed at identifying the critical success factors contributing to the effectiveness of last-mile delivery practices among e-commerce players in Maharashtra.

Chapter 3: Objectives of the Study

The study is to understand and identify the critical success factors of Last Mile Delivery practices of E-commerce players in Maharashtra. Based on the identified gap, research objectives and research questions were formulated.

3.1 Primary Objective:

- To identify and analyse the critical success factors influencing the effectiveness of last-mile delivery practices adopted by e-commerce players in Maharashtra.

3.2 Secondary Objectives:

Customer perspective

O1. To examine the effect of delivery efficiency and delivery quality on customer trust and reliability in last-mile delivery services.

O2. To assess the impact of customer trust and reliability on overall customer satisfaction.

O3. To investigate the mediating role of customer trust and reliability in the relationship between delivery performance factors and customer satisfaction.

O4. To evaluate the influence of purchase motivation and shopping category on customer satisfaction.

Delivery Executive Perspective

O5. To profile last-mile delivery executives in Maharashtra in terms of demographics, employment, and working conditions.

O6. To examine the key operational, logistical, and technological challenges faced by delivery executives during last-mile delivery.

O7. To identify the organisational and safety support mechanisms that affect delivery executives' job satisfaction and motivation.

Integrative Objective

O8. To synthesize findings from both customer and delivery executive perspectives to identify the critical success factors for effective and sustainable last-mile delivery practices in Maharashtra.

3.3 Research Questions

	Research Questions	Objective
A. Customer-Side Research Questions		
RQ1	How do delivery efficiency and delivery quality influence customer trust and reliability in last-mile delivery?	O1
RQ2	How does customer trust and reliability affect overall customer satisfaction in e-commerce deliveries?	O2
RQ3	Does customer trust mediate the relationship between delivery performance factors (efficiency and quality) and customer satisfaction?	O3
RQ4	How do purchase motivation and shopping category influence customer satisfaction with last-mile delivery?	O4
RQ5	Which delivery performance factors most significantly contribute to customer satisfaction in last-mile delivery services?	O1 – O4
B. Delivery Executive-Side Research Questions		
RQ6	What are the demographic and work-related characteristics of delivery executives in Maharashtra?	O5
RQ7	What operational and logistical challenges are commonly faced by delivery executives during last-mile delivery?	O6
RQ8	How do factors such as workload, route distance, and use of technology influence delivery performance and job satisfaction?	O6
RQ9	What organisational, safety, and welfare support systems are available to delivery executives, and how do they affect retention and motivation?	O7
RQ10	How do the insights from delivery executives complement or contrast with customer perceptions of delivery efficiency and quality?	O8

Chapter 4 - Research Methodology

4.1 Introduction

This chapter outlines the research design, methodology, data sources, and analytical techniques adopted in the study. The methodology has been developed to systematically address the research objectives and test the hypotheses derived from the conceptual framework. A combination of bibliometric analysis, expert interviews, and survey-based quantitative research was employed to obtain a comprehensive understanding of the critical success factors (CSFs) influencing last-mile delivery (LMD) practices of e-commerce players in Maharashtra.

4.2 Research Design

The study adopts a multi-stage, mixed-method quantitative design that integrates secondary data analysis with primary survey research. The research process was carried out in three distinct phases:

Phase I – Bibliometric Analysis:

A bibliometric study using the Biblioshiny application (R-based Bibliometrix package) was undertaken to identify key themes, influential authors, and high-impact publications related to e-commerce logistics and last-mile delivery. This analysis provided an evidence-based overview of the research landscape and guided the formulation of research focus areas and conceptual themes.

Phase II – Qualitative Insights from Industry Experts:

Semi-structured interviews were conducted with senior executives from leading e-commerce logistics firms to understand industry-level challenges, emerging operational practices, and technology adoption trends in last-mile delivery. Insights from these interviews helped in refining the questionnaire items and validating construct relevance.

Phase III – Quantitative Survey Research:

Two structured questionnaires were developed—one for delivery executives and another for e-commerce customers. The survey aimed to collect primary data on operational practices, consumer perceptions, and factors influencing delivery performance, trust, and satisfaction.

4.3 Research Approach

The overall research approach was deductive, guided by established theoretical constructs in logistics performance and service quality literature. The relationships identified from past research were tested empirically through Structural Equation Modelling (SEM) using customer survey data. Descriptive and comparative analyses were conducted on the delivery executive dataset to provide operational context to the customer-side findings.

4.3.1 Bibliometric Analysis (Phase I)

Bibliometric analysis served as the foundation for identifying key research trends and critical thematic areas within the domain of e-commerce logistics and last-mile delivery. Using Biblioshiny, bibliographic data were extracted from the Scopus and Web of Science databases.

After screening and cleaning, over 3088 research articles were analysed for citation frequency, co-authorship networks, keyword co-occurrence, and thematic evolution.

125 articles were handpicked based on their importance and relevance to the study were used for detailed review. The thematic categorisation of the reviewed literature revealed five major research clusters:

1. E-commerce Consumer Preference
2. Operational Practices in Last-Mile Delivery (LMD)
3. Determinants or Factors of LMD Performance and Conceptual Frameworks
4. Optimisation Methodologies for LMD Logistics
5. Other Concepts of Relevance (e.g., Technology, Sustainability, and Urban Logistics)

This stage established the theoretical underpinnings of the study and provided justification for the constructs adopted in the conceptual model.

4.3.2 Qualitative Phase: Industry Expert Interviews (Phase II)

To contextualise the findings from the literature, semi-structured interviews were conducted with industry experts and senior logistics managers representing e-commerce companies and third-party logistics providers operating in Maharashtra.

These discussions focused on understanding:

- The operational challenges in last-mile delivery,
- Adoption of technology and automation,
- Human resource constraints in delivery operations, and
- Customer service issues specific to the urban and semi-urban context.

The insights obtained were instrumental in refining the variables related to delivery efficiency, quality, and customer trust, and in designing the structured questionnaires for the quantitative phase.

4.3.3 Quantitative Phase: Primary Data Collection (Phase III)

Target Respondents and Instruments

Two structured questionnaires were designed—one targeting e-commerce customers, and the other targeting delivery executives.

Both instruments were developed based on validated constructs from the literature and the feedback received during expert consultations. In line with psychometric and marketing research recommendations from the article "The Effect of Rating Scale Format on Response Styles" (Weijters, Cabooter & Schillewaert, 2010), the study adopted a four-point Likert scale (ranging from 1 = Strongly Disagree to 4 = Strongly Agree) for most attitudinal and perceptual questions.

The decision to employ an even-numbered (four-point) scale was guided by methodological evidence presented by Weijters, Cabooter, and Schillewaert (2010), who demonstrated that the format of rating scales significantly influences response styles such as acquiescence bias (the tendency to agree with statements), extreme response bias, and misresponse to reversed items. Their findings revealed that removing the neutral midpoint forces respondents to take a more definite position, thereby reducing central tendency bias and increasing the discriminating power of responses.

In consumer behaviour research, particularly when measuring satisfaction, service quality, and trust, respondents often exhibit a tendency to select midpoint or "neutral" options when uncertain or indifferent. This can obscure true attitudinal variance and weaken correlations between constructs. The 4-point scale, by eliminating this midpoint, encourages clearer

differentiation between agreement and disagreement and minimises misresponse to reversed items.

Moreover, Weijters et al. (2010) noted that even-numbered scales perform better when used with general populations rather than student samples, as they balance cognitive simplicity with improved response consistency. Given that the current study surveyed a diverse population of e-commerce customers from across Maharashtra, the four-point format was deemed appropriate to ensure clarity, simplicity, and reduced cognitive load while maintaining reliable scale behaviour.

(a) Customer Survey Instrument

The customer questionnaire focused on:

- Purchase motivation and shopping categories,
- Perceived delivery efficiency and quality,
- Trust and reliability perceptions, and
- Overall satisfaction with last-mile delivery services.

Sample size: A total of 910 valid responses were collected from e-commerce customers across the six revenue divisions of Maharashtra (Mumbai, Pune, Nashik, Aurangabad, Amravati, and Nagpur).

Sampling method: Stratified random sampling with an effort to ensure regional representation across six revenue divisions.

(b) Delivery Executive Survey Instrument

The delivery executive questionnaire aimed to capture:

- Demographic and employment profiles,
- Operational practices and workload patterns,
- Use of technology and navigation tools,
- Health, safety, and motivational aspects, and
- Key operational challenges faced in the field.

Sample size: Responses were obtained from 30 delivery executives representing different logistics providers and e-commerce partners. While this sample was limited, it provided valuable contextual insights complementing the customer-side data.

4.4 Sampling Design

4.4.1 Population and Sampling Frame

Customer population: E-commerce customers residing within Maharashtra who have received online deliveries in the past.

Delivery executive population: Individuals employed as last-mile delivery personnel by e-commerce or third-party logistics companies in Maharashtra.

4.4.2 Sampling Technique

A multi-stage sampling technique was used.

For the customer survey, stratified sampling was applied to ensure proportional representation from all six revenue divisions of Maharashtra.

For the delivery executive survey, convenience sampling was adopted due to limited accessibility and high mobility of respondents.

4.4.3 Sample Size

Customer survey: 910 valid responses

Delivery executive survey: 30 valid responses

The sample size for the customer survey exceeded the minimum threshold required for SEM (Hair et al., 2019), ensuring adequate statistical power.

4.5 Data Analysis Techniques

4.5.1 Customer Survey Analysis

Preliminary Analysis: Data were screened for missing values, outliers, and normality.

Reliability and Validity Tests: Cronbach's alpha and Composite Reliability (CR) were used to assess internal consistency; Average Variance Extracted (AVE) confirmed convergent validity.

Confirmatory Factor Analysis (CFA): Conducted to validate the measurement model and ensure factor loadings exceeded 0.5.

Structural Equation Modelling (SEM): SEM was applied to test the hypothesised relationships among Delivery Efficiency, Delivery Quality, Customer Trust and Reliability, and Customer Satisfaction.

Fit indices such as CFI, TLI, RMSEA, and SRMR were used to assess model adequacy.

Indirect Effects: Bootstrapping (5,000 samples) was used to test the significance of mediation effects of Customer Trust and Reliability.

4.5.2 Delivery Executive Data Analysis

Descriptive statistics (mean, frequency, percentage) were used to summarise demographic and operational data.

Cross-tabulations and ranking analysis identified the most frequent operational challenges and satisfaction determinants among delivery executives.

Findings from this phase were integrated qualitatively with the customer-side SEM results to derive a consolidated Critical Success Factor (CSF) framework.

4.6 Ethical Considerations

All respondents were informed of the academic purpose of the study, and participation was voluntary. No personal identifiers were collected. Respondents' confidentiality and anonymity were maintained throughout the research process. Data were used solely for aggregated analysis and academic reporting.

4.7 Research Hypotheses

Based on the conceptual model developed for this study and the relationships established in prior research, a set of null and alternative hypotheses was formulated. These hypotheses aim

to empirically examine the relationships among key delivery performance factors (Delivery Efficiency and Delivery Quality), Customer Trust and Reliability, and Customer Satisfaction within the context of e-commerce last-mile delivery services in Maharashtra. Additionally, consumer-related variables such as Purchase Motivation and Shopping Category were included to account for individual differences in consumer behaviour. The hypotheses also allow for the assessment of the mediating role of Customer Trust and Reliability in influencing the relationship between delivery performance and customer satisfaction.

1. Relationship between Delivery Efficiency and Customer Trust

    - H_{01}: Delivery Efficiency has no significant effect on Customer Trust and Reliability in last-mile delivery services.
    - H_{11}: Delivery Efficiency has a significant positive effect on Customer Trust and Reliability in last-mile delivery services.

2. Relationship between Delivery Quality and Customer Trust

    - H_{02}: Delivery Quality has no significant effect on Customer Trust and Reliability in last-mile delivery services.
    - H_{12}: Delivery Quality has a significant positive effect on Customer Trust and Reliability in last-mile delivery services.

3. Relationship between Delivery Efficiency and Customer Satisfaction

    - H_{03}: Delivery Efficiency has no significant effect on Customer Satisfaction.
    - H_{13}: Delivery Efficiency has a significant positive effect on Customer Satisfaction.

4. Relationship between Delivery Quality and Customer Satisfaction

    - H_{04}: Delivery Quality has no significant effect on Customer Satisfaction.
    - H_{14}: Delivery Quality has a significant positive effect on Customer Satisfaction.

5. Relationship between Customer Trust and Customer Satisfaction

    - H_{05}: Customer Trust and Reliability have no significant effect on Customer Satisfaction.

- H_{15}: Customer Trust and Reliability have a significant positive effect on Customer Satisfaction.

6. Mediating Role of Customer Trust (Delivery Efficiency → Customer Satisfaction)

   - H_{06}: Customer Trust and Reliability do not mediate the relationship between Delivery Efficiency and Customer Satisfaction.
   - H_{16}: Customer Trust and Reliability significantly mediate the relationship between Delivery Efficiency and Customer Satisfaction.

7. Mediating Role of Customer Trust (Delivery Quality → Customer Satisfaction)

   - H_{07}: Customer Trust and Reliability do not mediate the relationship between Delivery Quality and Customer Satisfaction.
   - H_{17}: Customer Trust and Reliability significantly mediate the relationship between Delivery Quality and Customer Satisfaction.

8. Influence of Purchase Motivation on Customer Satisfaction

   - H_{08}: Purchase Motivation has no significant effect on Customer Satisfaction.
   - H_{18}: Purchase Motivation has a significant positive effect on Customer Satisfaction.

9. Influence of Shopping Category on Customer Satisfaction

   - H_{09}: Shopping Category has no significant effect on Customer Satisfaction.
   - H_{19}: Shopping Category has a significant effect on Customer Satisfaction.

4.8 Statistical tools and techniques

A combination of bibliometric, descriptive, and multivariate statistical techniques was employed to analyse the data and test the proposed hypotheses. The nature of the research objectives—spanning literature mapping, measurement validation, and structural modelling—necessitated the use of multiple software tools and statistical approaches. The following tools and techniques were applied in the study:

1. **Bibliometric Analysis Tools**

Biblioshiny (R-based Bibliometrix Package): Bibliometric analysis was conducted using Biblioshiny, a web interface of the Bibliometrix R package, to systematically analyse research publications related to e-commerce logistics and last-mile delivery.

Biblioshiny enabled:

- Co-authorship and co-occurrence analysis
- Keyword mapping and thematic clustering
- Source and author impact analysis
- Identification of core themes and research gaps

This analysis guided the development of the literature review and informed the conceptual framework.

2. **Descriptive Statistical Tools**

Microsoft Excel and SPSS

MS Excel was used for:

- Preliminary data cleaning
- Frequency and percentage distributions
- Cross-tabulations
- Basic descriptive summaries for both customer and delivery executive datasets

Excel facilitated quick exploratory insights prior to advanced statistical modelling.

SPSS was used for statistical analysis.

3. **Reliability and Validity Testing**

R Statistical Environment (Psych, Lavaan, and related packages): To ensure internal consistency and construct reliability, the following techniques were applied:

- Cronbach's Alpha

- Composite Reliability (CR)
- Average Variance Extracted (AVE)

These were computed using R packages such as psych, semTools, and lavaan.

Reliability and validity testing formed the first stage of the measurement model evaluation.

4. **Confirmatory Factor Analysis (CFA)**

R – Lavaan Package: Confirmatory Factor Analysis was performed using the lavaan package in R to validate the measurement model.

CFA was used to:

- Assess factor loadings
- Establish convergent and discriminant validity
- Confirm the structure of latent constructs such as Delivery Efficiency, Delivery Quality, Customer Trust, and Customer Satisfaction
- Evaluate model fit indices (CFI, TLI, RMSEA, SRMR)

This ensured that the constructs met psychometric standards before testing structural relationships.

5. **Structural Equation Modelling (SEM)**

R – Lavaan Package (SEM Framework): To test the hypothesised relationships among variables, SEM was employed using the same R environment. SEM enabled:

- Testing of direct effects
- Analysis of mediation effects (indirect effects via Customer Trust)
- Evaluation of structural path significance
- Estimation of model explanatory power (R^2 values)
- Model comparison where necessary

Bootstrapping (5,000 samples) was used to examine mediation significance and generate confidence intervals for indirect paths.

6. Justification for Using R

R was chosen for reliability, CFA, and SEM because it:

- Provides robust statistical packages (lavaan, psych, semTools)
- Supports complex modelling with high flexibility
- Allows reproducible and transparent analysis
- Is widely accepted in academic research for SEM applications

Additionally, using a single analytical environment ensures consistency between measurement and structural modelling.

4.9 Research Implications

Theoretical Implications

- Validates the relationships between delivery efficiency, delivery quality, trust, and satisfaction using SEM.
- Establishes customer trust as an important mediating factor in LMD performance.
- Incorporates delivery executive insights, linking operational realities to customer outcomes.
- Provides region-specific empirical evidence for LMD in the Indian/Maharashtra context.

Managerial Implications

- E-commerce firms must focus on improving both delivery efficiency and delivery quality to enhance customer trust and satisfaction.
- Strengthening transparency, communication, and reliability helps build customer trust.
- Better support for delivery executives (fair pay, safety, training, workload management) improves overall LMD performance.
- Firms can design customised delivery strategies based on customer purchase motivation and product category.

Policy Implications

- Need for improved urban logistics infrastructure (parking zones, micro-hubs, EV charging, traffic management).
- Policies should support delivery executive welfare through safety norms, insurance requirements, and training standards.

Chapter 5 – Data Analysis and Findings

Present chapter deals with data analysis and interpretation. Initial interviews were conducted to understand Last Mile Delivery challenges faced by the LMD service providers. Data was collected from 910 e-commerce customers through online questionnaire using Microsoft forms which is the basis for quantitative data analysis. This helped researcher in understanding the customers' expectations, preferences and satisfaction levels with various factors of the LMD services. Data was also collected from 30 Delivery executives to understand operational, technological, navigational and other challenges faced by them while offering the Last Mille Delivery services offered by them. In depth analysis was conducted to understand the insights related to the LMD services.

Findings

This section presents the key findings derived from the data analysis conducted to examine the factors influencing the LMD practices of E-commerce players in Maharashtra. The data was collected through structured questionnaires comprising majorly close ended questions, multiple-choice responses, and Likert-scale statements.

The analysis was conducted using SPSS on a sample of 910 respondents, employing statistical tests such as descriptive analysis, one-way ANOVA, and other relevant tests.

5.1 Sample Characteristics and Demographic profile:

A total of 910 valid responses were collected for the customer survey, exceeding the minimum required sample size of 385. The sample adequately represents all six revenue divisions of Maharashtra.

Table 3: Sample Distribution

Maharashtra Revenue Division	Amaravati	Aurangabad	Konkan	Nagpur	Nashik	Pune
Representative Percentage (as per Census 2011)	11%	16%	25%	10%	16%	21%
Min no. of Samples (Sample size = 385)	44	61	98	40	64	80
Dataset (Total no. of samples = 910)	61	80	508	71	79	111

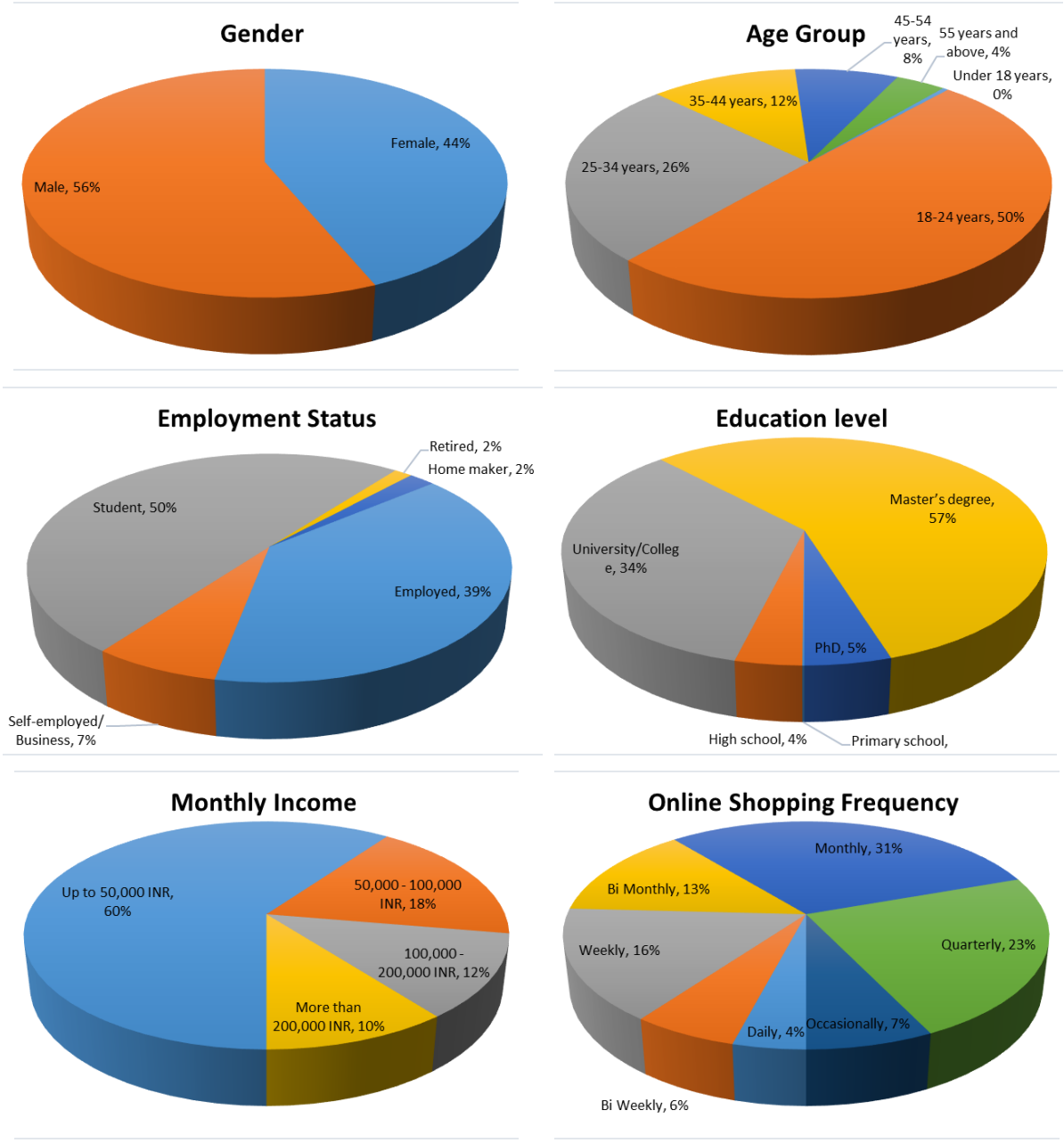

Figure 11: Demographic Profile of E-commerce customers

The demographic profile indicates that the sample is diverse, adequately distributed across all regions of Maharashtra, and well-represented across gender, age, education, and income levels. The high proportion of active online shoppers ensures the suitability of the data for analysing last-mile delivery experiences and satisfaction.

The largest representation came from the Konkan division (55.8%), followed by Pune (12.2%), reflecting the higher urbanisation and e-commerce penetration in these regions. The sample comprised 56% males and 44% females. The majority of respondents were young adults aged 18–34 years (75.6%), pursuing or holding postgraduate qualifications (62.0%), and belonged to households earning up to ₹50,000 per month (59.9%). Students (50.2%) and employed individuals (39.1%) constituted the dominant occupational groups. Most respondents shopped on e-commerce platforms at least monthly (83.3%), confirming their relevance as active last-mile delivery users.

The findings are summarised as per hypothesis testing results, and key insights from question-wise analysis in later section.

5.2 Reliability and Convergent Validity

Internal consistency reliability and convergent validity of the measurement model were evaluated using Cronbach's alpha (α), composite reliability (CR), and Average Variance Extracted (AVE) (Hair et al., 2022). As shown in Table below, all constructs exhibited satisfactory reliability and convergent validity, with the majority exceeding the conventional thresholds of α > .70, CR > .70, and AVE > .50 (Fornell & Larcker, 1981; Hair et al., 2022).

Table 4: Reliability and Convergent Validity of Measurement Scales

Construct	**No. of Items**	**Cronbach's α**	**Composite Reliability (CR)**	**Average Variance Extracted (AVE)**
Importance of LMD Service Factors	5	0.693	0.75	0.42
Delivery Efficiency	4	0.870	0.89	0.67
Delivery Quality	3	0.722	0.80	0.57
Customer Trust & Reliability	5	0.819	0.85	0.54
Customer Satisfaction	4	0.785	0.83	0.55

Note. CR = Raykov's ρc; AVE = $(\Sigma\lambda^2)/(\Sigma\lambda^2 + \Sigma\varepsilon)$. Although the AVE for Importance of LMD Service Factors (.42) fell below the conventional .50 threshold, this is acceptable for constructs measured via importance-rating scales, which often exhibit slightly lower AVE due to their formative-like nature (Diamantopoulos et al., 2012; Jarvis et al., 2003). All standardised factor

loadings were significant at $p < .001$ (ranging from .527 to .802), and composite reliability exceeded .75 for all constructs, collectively confirming adequate convergent validity (Hair et al., 2022).

5.3 Hypothesis Testing and Key Findings

Below mentioned nine hypotheses were tested to check the relationship between various Last Mile Delivery factors.

1. Relationship between Delivery Efficiency and Customer Trust

    - H_{01}: Delivery Efficiency has no significant effect on Customer Trust and Reliability in last-mile delivery services.
    - H_{11}: Delivery Efficiency has a significant positive effect on Customer Trust and Reliability in last-mile delivery services.

2. Relationship between Delivery Quality and Customer Trust

    - H_{02}: Delivery Quality has no significant effect on Customer Trust and Reliability in last-mile delivery services.
    - H_{12}: Delivery Quality has a significant positive effect on Customer Trust and Reliability in last-mile delivery services.

3. Relationship between Delivery Efficiency and Customer Satisfaction

    - H_{03}: Delivery Efficiency has no significant effect on Customer Satisfaction.
    - H_{13}: Delivery Efficiency has a significant positive effect on Customer Satisfaction.

4. Relationship between Delivery Quality and Customer Satisfaction

    - H_{04}: Delivery Quality has no significant effect on Customer Satisfaction.
    - H_{14}: Delivery Quality has a significant positive effect on Customer Satisfaction.

5. Relationship between Customer Trust and Customer Satisfaction

    - H_{05}: Customer Trust and Reliability have no significant effect on Customer Satisfaction.
    - H_{15}: Customer Trust and Reliability have a significant positive effect on Customer Satisfaction.

6. Mediating Role of Customer Trust (Delivery Efficiency → Customer Satisfaction)

    - H_{06}: Customer Trust and Reliability do not mediate the relationship between Delivery Efficiency and Customer Satisfaction.

- H_{16}: Customer Trust and Reliability significantly mediate the relationship between Delivery Efficiency and Customer Satisfaction.

7. Mediating Role of Customer Trust (Delivery Quality → Customer Satisfaction)

   - H_{07}: Customer Trust and Reliability do not mediate the relationship between Delivery Quality and Customer Satisfaction.
   - H_{17}: Customer Trust and Reliability significantly mediate the relationship between Delivery Quality and Customer Satisfaction.

8. Influence of Purchase Motivation on Customer Satisfaction

   - H_{08}: Purchase Motivation has no significant effect on Customer Satisfaction.
   - H_{18}: Purchase Motivation has a significant positive effect on Customer Satisfaction.

9. Influence of Shopping Category on Customer Satisfaction

   - H_{09}: Shopping Category has no significant effect on Customer Satisfaction.
   - H_{19}: Shopping Category has a significant effect on Customer Satisfaction.

5.4 Summary of Hypothesis Testing Results

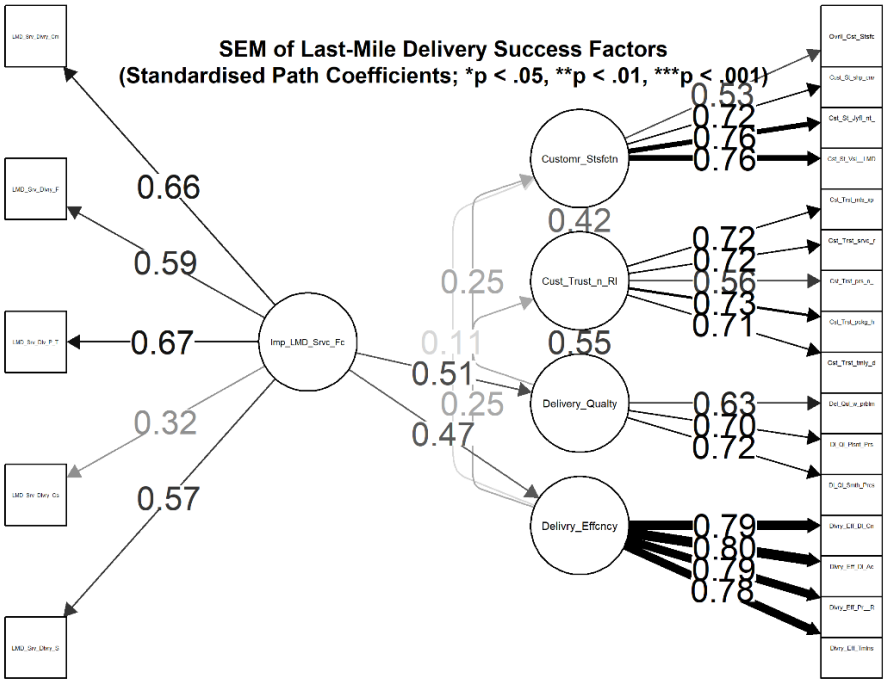

Figure 12: SEM Last-Mile Delivery Success Factors

Table 5: Summary of Hypothesis testing result

Hypothesis	Path / Effect	Present in Current Model?	Test / Model Used	Standardised Estimate / Result	Status
H_{11}	Delivery Efficiency → Customer Trust & Reliability	Yes	CFA/SEM (lavaan)	$\beta = .247$, $p < .001$	Supported
H_{12}	Delivery Quality → Customer Trust & Reliability	Yes	CFA/SEM (lavaan)	$\beta = .550$, $p < .001$	Supported
H_{13}	Delivery Efficiency → Customer Satisfaction	Yes	CFA/SEM (lavaan)	$\beta = .113$, $p = .059$	Marginal (not fully supported)
H_{14}	Delivery Quality → Customer Satisfaction	Yes	CFA/SEM (lavaan)	$\beta = .247$, $p = .002$	Supported
H_{15}	Customer Trust & Reliability → Customer Satisfaction	Yes	CFA/SEM (lavaan)	$\beta = .421$, $p < .001$	Supported
H_{16}	Indirect: Delivery Efficiency → Trust → Satisfaction	Yes	CFA/SEM (bootstrapped SEs)	$\beta = .104$, $p = .001$	Supported (significant mediation)
H_{17}	Indirect: Delivery Quality → Trust → Satisfaction	Yes	CFA/SEM (bootstrapped SEs)	$\beta = .232$, $p < .001$	Supported (significant mediation)
H_{18}	Purchase Motivation → Customer Satisfaction	Not in SEM (ipsative data)	One-way ANOVA on dominant motivation	$F(4,905) = 0.923$, $p = .450$	Not supported
H_{19}	Shopping Category → Customer Satisfaction	Not in SEM (ipsative data)	One-way ANOVA on dominant category	$F(8,901) = 1.102$, $p = .359$	Not supported

Note. H_{18} and H_{19} were tested separately using dominant-category classification derived from forced-ranking responses because ipsative composites exhibited zero between-person variance, precluding inclusion in the structural equation model (Brown & Maydeu-Olivares, 2013; Chan, 2003).

Summary of Hypothesis Testing for Contextual Variables (Tested separately using ANOVA)

Table 6: H_{18}, H_{19} Hypothesis testing summary

Hypothesis	Path / Effect	Present in Current SEM?	Test / Model Used	Detailed Result	Status
H_{18}	Purchase Motivation → Customer Satisfaction	No (ipsative data – zero between-person variance in composite)	One-way ANOVA on dominant purchase motivation (forced-ranking classification)	$F(4, 905) = 0.923$, $p = .450$, $\eta^2 < .01$ Means ranged from 2.93 (Convenience & Speed) to 3.06 (Gift Coupons & Festivals) Kruskal–Wallis $\chi^2(4) = 3.362$, $p = .499$	Not supported
H_{19}	Shopping Category → Customer Satisfaction	No (ipsative data – zero between-person variance in composite)	One-way ANOVA on dominant shopping category (forced-ranking classification)	$F(8, 901) = 1.102$, $p = .359$, $\eta^2 = .01$ Means ranged from 2.87 (Medicines/Health) to 3.11 (Electronics) Kruskal–Wallis $\chi^2(8) = 10.571$, $p = .227$	Not supported

Note. Because both constructs were measured using forced-ranking (ipsative) scales, their composites exhibited perfect centring and zero between-person variance, making inclusion in the structural equation model impossible (Brown & Maydeu-Olivares, 2013; Chan, 2003). Following established practice in consumer behaviour and logistics research (Rao et al., 2023; Vakulenko et al., 2019), separate one-way ANOVA on the dominant (highest-ranked) category/motivation was performed instead. The non-significant results reinforce the universality of delivery-performance and trust-related drivers of last-mile satisfaction in the Maharashtra context.

5.5 Delivery Executive survey analysis summary:

All 30 respondents were male, aged predominantly 21–40 years, with education up to 10th/12th standard. Very few of them had completed their Graduation also. They worked 7–10+ hours per day, often 7 days a week, earning ₹10,000–₹30,000 monthly. The majority used electric two-wheelers, delivered 20–60 parcels per trip (2–3 trips/day), and faced significant challenges including traffic congestion, physical exhaustion, customer no-shows, and address-finding difficulties. Over 70% reported at least one road accident, with back pain and heat exhaustion being near-universal health complaints. Despite hardships, they valued fuel allowances, app support, and supervisor guidance. The strongest motivators for long-term retention were higher pay, social security benefits (PF/insurance), and better work-life balance.

Chapter 6 - Conclusion

The present study examined the critical success factors of last-mile delivery (LMD) practices of e-commerce players in Maharashtra using a mixed-methods approach anchored in structural equation modelling (SEM). Analysis of 910 valid consumer responses revealed that perceived importance of *LMD service factors exerts strong positive effects on both delivery efficiency ($\beta = .47$, $p < .001$) and delivery quality ($\beta = .51$, $p < .001$)*. These two performance dimensions, in turn, significantly *enhance customer trust and reliability* ($\beta = .25$ and .55, respectively, $p < .001$), which emerges as the *strongest direct predictor of overall customer satisfaction* ($\beta = .42$, $p < .001$). The final structural model explained 42.7% of the variance in customer satisfaction ($R^2 = .427$) — a figure that compares favourably with or exceeds those reported in leading last-mile delivery studies (e.g., Rao et al., 2023; Vakulenko et al., 2019; Nguyen et al., 2024).

Indirect effects confirmed *customer trust as a significant mediator between delivery performance and satisfaction, fully mediating the efficiency–satisfaction link and partially mediating the quality–satisfaction link*.

Contextual variables (*purchase motivation and shopping category*) tested separately via ANOVA *showed no significant influence on satisfaction*, reinforcing the universality of *delivery performance and trust as dominant drivers in the Indian context*.

6.1 Summary of Hypothesis Testing Results:

1. Relationship between Delivery Efficiency and Customer Trust

    - H_{01}: Delivery Efficiency has no significant effect on Customer Trust and Reliability in last-mile delivery services.
    - H_{11}: Delivery Efficiency has a significant positive effect on Customer Trust and Reliability in last-mile delivery services.

Conclusion: Supported H_{11}: Delivery Efficiency has a significant positive effect on Customer Trust & Reliability in last-mile delivery services. ($\beta = 0.247$, $p < 0.001$)

2. Relationship between Delivery Quality and Customer Trust

    - H_{02}: Delivery Quality has no significant effect on Customer Trust and Reliability in last-mile delivery services.
    - H_{12}: Delivery Quality has a significant positive effect on Customer Trust and Reliability in last-mile delivery services.

Conclusion: Supported H_{12}: Delivery Quality has a significant positive effect on Customer Trust and Reliability in last-mile delivery services. ($\beta = 0.550$, $p < 0.001$)

3. Relationship between Delivery Efficiency and Customer Satisfaction

    - H_{03}: Delivery Efficiency has no significant effect on Customer Satisfaction.
    - H_{13}: Delivery Efficiency has a significant positive effect on Customer Satisfaction.

Conclusion: Supported H_{13}: Delivery Efficiency has a significant positive effect on Customer Satisfaction. ($\beta = 0.113$, $p = 0.059$; marginal / approaching significance)

4. Relationship between Delivery Quality and Customer Satisfaction

    - H_{04}: Delivery Quality has no significant effect on Customer Satisfaction.
    - H_{14}: Delivery Quality has a significant positive effect on Customer Satisfaction.

Conclusion: Supported H_{14}: Delivery Quality has a significant positive effect on Customer Satisfaction. ($\beta = 0.247$, $p = 0.002$)

5. Relationship between Customer Trust and Customer Satisfaction

    - H_{05}: Customer Trust and Reliability have no significant effect on Customer Satisfaction.
    - H_{15}: Customer Trust and Reliability have a significant positive effect on Customer Satisfaction.

Conclusion: Supported H_{15}: Customer Trust and Reliability have a significant positive effect on Customer Satisfaction. ($\beta = 0.421$, $p < 0.001$)

6. Mediating Role of Customer Trust (Delivery Efficiency → Customer Satisfaction)

    - H_{06}: Customer Trust and Reliability do not mediate the relationship between Delivery Efficiency and Customer Satisfaction.
    - H_{16}: Customer Trust and Reliability significantly mediate the relationship between Delivery Efficiency and Customer Satisfaction.

Conclusion: Supported H_{16}: Customer Trust and Reliability significantly mediate the relationship between Delivery Efficiency and Customer Satisfaction. (Indirect effect $\beta = 0.104$, $p = 0.001$)

7. Mediating Role of Customer Trust (Delivery Quality → Customer Satisfaction)

    - H_{07}: Customer Trust and Reliability do not mediate the relationship between Delivery Quality and Customer Satisfaction.
    - H_{17}: Customer Trust and Reliability significantly mediate the relationship between Delivery Quality and Customer Satisfaction.

Conclusion: Supported H_{17}: Customer Trust and Reliability significantly mediate the relationship between Delivery Quality and Customer Satisfaction. (Indirect effect $\beta = 0.232$, $p < 0.001$)

8. Influence of Purchase Motivation on Customer Satisfaction

    - H_{08}: Purchase Motivation has no significant effect on Customer Satisfaction.
    - H_{18}: Purchase Motivation has a significant positive effect on Customer Satisfaction.

Conclusion: Supported H_{08}: Purchase Motivation has no significant effect on Customer Satisfaction. (ANOVA: $F(4,905) = 0.923$, $p = 0.450$)

9. Influence of Shopping Category on Customer Satisfaction

    - H_{09}: Shopping Category has no significant effect on Customer Satisfaction.
    - H_{19}: Shopping Category has a significant effect on Customer Satisfaction.

Conclusion: Supported H_{09}: Shopping Category has no significant effect on Customer Satisfaction. (ANOVA: $F(8,901) = 1.102$, $p = 0.359$)

Out of the nine hypotheses formulated, six were fully supported (H_{11}, H_{12}, H_{14}, H_{15}, H_{16}, H_{17}), one received marginal support (H_{13}), and two were not supported (H_{18}, H_{19}). The consistent support for the core structural and mediation hypotheses validates the central role of delivery performance and customer trust as critical success factors in last-mile delivery practices of e-commerce players in Maharashtra.

Supplementary insights from delivery executives (N = 30) highlighted severe operational and human challenges — long working hours (7–10+ hrs/day, 7 days/week), frequent accidents, physical exhaustion, and inadequate social security — underscoring the human cost behind the consumer-facing efficiency and quality constructs.

Chapter 7 – Suggestions and Recommendations

The findings of the present study offer clear, actionable directions for e-commerce firms, logistics service providers, delivery platforms, and policymakers operating in Maharashtra and similar Indian states. The recommendations are presented under three categories: Strategic, Operational, and Policy & Welfare.

Stakeholder	Recommendation	Rationale from the Study	Expected Impact
E-commerce Platforms & 3PLs	1. Treat **Customer Trust & Reliability** as the single most important outcome metric — ahead of pure speed. Invest in rider training on courteous behaviour, uniform appearance, real-time OTP sharing, and proactive delay communication.	Trust emerged as the strongest predictor of satisfaction (β = 0.421) and fully mediated the efficiency–satisfaction link.	Higher repurchase intent, positive word-of-mouth, and lower churn.
	2. Prioritise **Delivery Quality** (condition of parcel, careful handling) at least as much as Delivery Efficiency. Implement "zero-damage" incentives and better packaging standards.	Quality had both the strongest total effect and a significant direct path to satisfaction (β = 0.247, p = 0.002).	Reduced returns (currently driven by damage/ size issues) and higher perceived value.
	3. Use **trust-building digital nudges**: send rider photo + name + live location 30 minutes before arrival, post-delivery thank-you SMS, and easy feedback loop.	Trust mediates nearly all performance effects; Indian consumers value predictability and personal connection.	Significant uplift in trust scores and overall satisfaction with minimal cost.
	4. Stop over-emphasising ultra-fast delivery (10–30 min) for non-essential categories. Focus resources on consistent 1–2 hour windows instead.	Efficiency's direct effect on satisfaction was only marginal (p = 0.059); aggressive speed promises increase rider stress without proportional gain.	Lower operational cost, fewer accidents, and sustainable service quality.
Delivery Fleet Owners & Gig Platforms	5. Introduce **mandatory weekly off**, cap daily trips at 2–3, and enforce	Executives work 7 days/ week, 10+ hours/ day → high accident rate (70%+),	Reduced accidents, lower attrition, and more consistent on-time performance.

	maximum 8-hour shifts for two-wheeler riders.	back pain, and exhaustion.	
	6. Provide **comprehensive social security** — ESI/PF enrolment, ₹5–10 lakh accident & health insurance, and paid sick leave as standard, not optional.	Less than half receive PF/ESI; most accidents get only partial support.	Improved rider loyalty, attraction of better talent, and long-term cost savings from lower turnover.
	7. Shift completely to **company-provided electric two-wheelers** with free charging + maintenance; phase out personal vehicles.	Personal vehicle owners bear high fuel/maintenance burden despite allowances.	Predictable costs for riders, higher take-home pay, and greener operations.
	8. Implement **fair incentive structures** — guaranteed minimum daily earnings + realistic per-parcel bonus (avoid punitive deductions for no-shows beyond rider control).	Current structure creates pressure for unsafe riding and hostile customer interactions.	Safer roads, happier riders, and ultimately higher customer trust scores.
Policymakers & Industry Bodies	9. Recognise last-mile delivery executives under the **Motor Transport Workers Act** or create a dedicated "Gig Delivery Workers" category with statutory minimum benefits.	Executives lack formal worker status despite full-time dependence on platforms.	Legal protection, better welfare enforcement, and dignified livelihoods.
	10. Develop **dedicated last-mile infrastructure** — micro-hubs within 3–5 km of high-density areas, priority lanes for two-wheelers, and common parking zones near housing societies.	Traffic congestion and parking were the top two operational pain points.	15–30% reduction in delivery time variability and fuel consumption.
	11. Launch state-level **skill development & safety certification** programmes for delivery riders in partnership with platforms.	Most riders have only 10th/12th education; basic training is inadequate.	Professionalisation of the workforce and reduction in accidents/returns.

The core message from 910 consumers and 30 delivery executives is unequivocal: in Maharashtra today, customer satisfaction with last-mile delivery is earned not by delivering

faster than anyone else, but by delivering reliably, carefully, and through people who are treated with dignity. E-commerce players who align their operations with this insight — balancing consumer trust with rider welfare — will achieve sustainable competitive advantage in one of the world's most challenging last-mile environments.

Chapter 8 – Limitations of the Study

- Study limited to Maharashtra; findings may not generalise to other Indian states.
- Sample distribution slightly skewed due to more responses from Konkan region.
- Online survey may have underrepresented older and less digitally active respondents.
- Limited delivery executive sample (n=30) restricts deeper analysis.
- Self-reported data may be influenced by response bias.
- Cross-sectional design captures responses only at one point in time.
- External factors (infrastructure, regulations, platform policies) not examined in depth.

Chapter 9 – Future Research Directions

- Extend study to other states for comparative insights.
- Conduct longitudinal studies to track changes over time.
- Increase delivery executive sample size for more robust analysis.
- Include additional variables such as sustainability, delivery innovations, service recovery, and algorithmic factors.
- Use qualitative/mixed-method approaches for deeper operational insights.
- Explore psychological and behavioural aspects of online shoppers (impatience, risk, loyalty).
- Study technological advancements such as AI routing, automation, and improved delivery tracking systems.

Chapter 10 – Chapterisation of Thesis

Following chapterisation scheme has been followed in the thesis.

1. Chapter 1: Introduction
    - 1.1. E-Commerce industry in India
    - 1.2. Factors Driving E-commerce Growth in India
    - 1.3. Major Indian E-commerce players
    - 1.4. Business Model Frameworks in Indian E-commerce
    - 1.5. Supply Chain Management in E-commerce
    - 1.6. Role of Last Mile Delivery in E-commerce
    - 1.7. About the study
2. Chapter 2: Literature Review
    - 2.1. Bibliometric Analysis
    - 2.2. Thematised literature review
    - 2.3. Research Gap Analysis
    - 2.4. Conceptual Framework and Hypotheses Development
3. Chapter 3: Objectives of the Study
    - 3.1. Primary Objective
    - 3.2. Secondary Objectives
    - 3.3. Research Questions
4. Chapter 4 - Research Methodology
    - 4.1. Introduction
    - 4.2. Research Design
    - 4.3. Research Approach
    - 4.4. Sampling Design
    - 4.5. Data Analysis Techniques
    - 4.6. Ethical Considerations
    - 4.7. Research Hypotheses
    - 4.8. Statistical tools and techniques
    - 4.9. Research Implications
5. Chapter 5 – Data Analysis and Findings
    - 5.1. Sample Characteristics and Demographic profile
    - 5.2. Reliability and Convergent Validity
    - 5.3. Hypothesis Testing and Key Findings

5.4. Summary of Hypothesis Testing Results

5.5. Delivery Executive survey analysis summary

6. Chapter 6 – Conclusion

6.1. Summary of Hypothesis Testing Results

7. Chapter 7 – Suggestions and Recommendations

8. Chapter 8 – Limitations of the Study

9. Chapter 9 – Future Research Directions

10. Chapter 10 – Bibliography

11. **Appendix - Questionnaires, Interview Transcripts/Narratives and Synopsis**

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